Understanding and Analysing the Italian Zespri Kiwifruit Chain Aiming on Opportunities for Enhancing Growers' Productivity

WAGENINGEN UNIVERSITY

Source: Zespri Website

Master Thesis

Student name: Andrea Del Zotto Falascina

Student number: 840528-990-080

Supervisor: Trienekens Jacques

Second supervisor: Bijman Jos

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Abstract

The global kiwifruit industry is concentrated among few producing countries: China, Italy, New Zealand and Chile. Although Italy is the second world producer and the first world exporter, limitations have been founded among Italian kiwifruit growers, which often show ineffectiveness in producing high quantity of standardized qualitative kiwifruit that meet trader's demand. In particular, Zespri is facing a shortage of supply of high quality kiwifruit that guarantees retails' shelf-space and its year-round supply strategy. As a consequence, Italian growers pay off fluctuates accordingly to the increasing competition and on market commodity quotations. This study focuses on Italian kiwifruit growers and chain players with the objective to identify opportunities for growers' productivity improvements. From the survey conducted on 74 kiwifruit growers located in the centre of Italy (Latina), followed by the analysis with SPSS, it emerged that kiwifruit farms are typically two/three hectares, overall growers are rather aged and not highly educated. *Psa* outbreak has seriously changed the sector and only basic orchard practices are applied by the majority of growers. Farms are largely managed by the single grower which is occasionally supported by family members. Scarcities in the farm management have also been identified in the limited use of complex orchard practices, specialized employees, their involvement in the farm decision-making process, interaction with experts, and team members' specializations. Other contributions have been identified within chain players where market information is not transparent. Findings demonstrate how in general kiwifruit farm management requires younger and educated managers together with chain players' initiatives aimed at increasing transparency and trust, and reinforce collaboration among chain players.

Key words: kiwifruit supply chain, Zespri chain, kiwifruit orchard management, kiwifruit farm productivity, Italian kiwifruit productivity.

Executive Summary

This report provides an analysis and evaluation of the current situation of 74 kiwifruit growers located in the centre of Italy (Latina), and their collaborations with cooperatives and Zespri. In particular this study has the objective *"To provide recommendations on opportunities for productivity improvements of the Italian Zespri kiwifruit chain by investigating how farm management practices and chain players' related activities have positive or negative effect on growers' performance"*. On one hand, the main focus is to investigate farm managerial and technical practices adopted; on the other hand, the study then refers to chain actors' activities and interests such as technical assistance, information exchange, diffusion of innovations, and chain management practices that might influence growers' productivity.

The research strategy includes a preliminary desk research combined with a survey approach. Through the literature review, theories concerning farm management and chain factors were selected and converted into indicators. Then, a questionnaire based on theories previously selected was designed to collect direct information from the target population. Analysis conducted with SPSS includes calculation of the answered questionnaires with descriptive statistics indicators describing main tendencies of the population. And 11 assumed relationships were formulated and calculated by correlation analysis.

Results of data analysis from the descriptive statistics show the common farm size is two hectares. Hayward and Zespri Gold are the most planted varieties. Overall growers are rather aged and not highly educated. Psa outbreak has seriously reduced the productivity of Gold growers. Kiwifruit growers show evident productivity gaps in the yield and OGR results, and top performing grower cases are found limited. According to the SPSS results, it is demonstrated that most farms are owned by single growers who do not hire specialized employees and tend to take decisions individually without consulting external experts. Meanwhile, the information shared is not transparent because growers are completely unaware of whom the cooperative's buyers are and what the prices kiwifruit sold at the bulk market are, however, the trust in Zespri and cooperative is rather positive. In general, the satisfaction about the actual production is rather low. Nonetheless, the sample has a positive projection about the future and they are willing to cooperate more with cooperatives and Zespri.

Based on the 11 relationships calculated in the correlation analysis, growers' productivity is positively related with satisfaction level, attitude towards adopting new varieties, farm technical practices (gel pruning and bio stimulants), the presence of specialized employees, and their involvements in the farm decision-making process. Moreover, from the other associations arose that solid teams tend to be more satisfied with cooperative support and know more market information. There are also correlations between growers visiting the Zespri Canopy website and the trust in cooperative and Zespri. Further findings of the remaining correlations are fully explained in Chapter 5.2 and additional calculations can be found in the text and Appendices IV.

In conclusion, the study shows clear associations of farm productivity with: (i) technical practices such as gel-pruning bio stimulants, (ii) farm management factors such as the presence of specialized employees and their involvement in the farm decision-making, and (iii) growers' attitudes such as high satisfaction level, bright future perspective, and importance of using new varieties. Major weaknesses identified as main opportunities to increase the productivity are in the farm management and in the

collaboration within the chain since the shared information appears to be not transparent. Thus, farm management should be renovated and information transparency within the chain should be enhanced.

Recommendations for further research discussed in this study are: (i) to further extend the data collection to a statistically sufficient number, (ii) to redesign the model by focusing on the factors impacting on farm technical practices, and (iii) to explore more the management structure of small, medium, and large kiwifruit farm. Regarding the industry players, the recommendations discussed are: (i) kiwifruit growers should invest more resources on the management of their farm by hiring younger managers with agricultural background, (ii) kiwifruit cooperatives should enhance the communication with growers by improving information transparency, and (iii) Zespri should implement productivity programmes used in New Zealand; and identify, select, recruit and retain the existing best growers to guarantee the supply of high quality kiwifruit.

Acknowledgements

I have achieved this study with the precious academic guidance from my supervisor, Dr. Jacques Trienekens. He has been very dedicated in providing me advice and in keeping me motivated. In particular, his research experience helped me to formulate a clear structure of the report, the proposal and in using a scientific approach to the topic investigated. He has always been a critical and inspiring about crucial aspects of the study and point out my carelessness. I am very grateful for the support and assistance he provided during the process.

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Finally, I would give the greatest thanks Ching Chiu who has been an important person in supporting me to accomplish this study. Furthermore, I dedicate this study to my parents who have always been supportive and had faith in me during my master program in Wageningen University. Especially, I would like to devote this study to my father and to all the people involved in our kiwifruit farm. Through this report I expect him to get important insights and thoughts on how to strengthen our farm management and consolidate the growth of the family business.

List of Abbreviations

(AGROS)	Agriculture Research Group on Sustainability
(CPPs)	Crop Protection Programmes
(DM)	Dry Matter
(FON)	Focus Orchard Network
(FSC)	Food Supply Chain
(KCPs)	Kiwifruit Chain Players
(KPIs)	Key Performance Indicators
(KVH)	Kiwifruit Vine Health
(LAI)	Leaf Area Index
(NAA)	Naphthalene Acetic Acid
(OGR)	Orchard Gate Return
(OMPs)	Orchard Management Practices
(OPC)	Orchard Productivity Centre
(PGI)	Protected Geographic Denomination
(SCM)	Supply Chain Management
(SPE)	Single Point of Entry
(VALS)	Value Added Logistic Services

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1 Introduction

In the last half century the kiwifruit industry has shown an interesting evolution. First kiwifruit commercial plantations were settled in New Zealand in the early 1940's for supplying the domestic market. In 1952 first export shipment of kiwifruit was sent to the United Kingdom and just about 20 years later, volumes exported rose rapidly (Kilgour, et al., 2007). Besides this trend, other countries experienced similar growth. Experimental plantations were settled in Italy in the early 1970's, and at the end of the 1980's 600-800 hectares were already planted (Testolin & Ferguson, 2009). The spread of kiwifruit took place also in Chile and in countries such as France, Greece, Japan, Korea and the United States (Ferguson, 2011).

Nowadays, kiwifruit is daily consumed as breakfast and lunch fruit. Its nutritional value, high content of potassium and vitamin C were crucial in its acceptance by consumers (Chattophday, 2008; Bano & Scrimgeour, 2011). The increase in kiwifruit consumption is also shown in the world kiwifruit availability (grams per capita) which grows from 50 grams in 1985 to more than 250 grams in 2010 (Belrose, 2011).

Rank	Country	1998-2001	Rank	Country	2008-2011
1	Italy	314,829	1	China	491,667
2	New Zealand	239,166	2	Italy	429,885
3	China	152,833	3	New Zealand	385,049
4	Chile	112,000	4	Chile	186,667
5	France	75,080	5	Greece	79,433
6	Greece	58,403	6	France	66,890
7	Japan	40,733	7	Japan	37,467
8	United States	29,514	8	Iran	30,000
9	Iran	21,677	9	United States	25,371
10	Korea, Rep	13,904	10	Korea, Rep	15,833
-	Top Five	893,908	-	Top Five	1,572,701
-	Percentage	82.5 %	-	Percentage	87.0 %
-	Top Ten	1,058,139	-	Top Ten	1,748,262
-	Percentage	97.6 %	-	Percentage	96.7 %
-	TOTAL	1,083,868	-	TOTAL	1,807,763

Source: Belrose, 2011

Table 1: Yearly production of the top ten kiwifruit producing countries by rank and tonnage in 1998-2001 and 2008-2011.

Nowadays, the world kiwifruit production is concentrated among a few countries of the Northern and Southern hemisphere and the top ten contribute over 95% of the world production (Table 1) (Bano & Scrimgeour, 2011; Belrose, 2011). According to the UN FAO data, China had surpassed the other countries in 2005 and produced 491,667 metric tons between 2008 and 2011. However, very few of the kiwifruit produced in China are exported due to the low quality and high internal consumption. As a result, the global market of kiwifruit is dominated by Italy (first exporter in the world), New Zealand (the leader in the southern hemisphere), and Chile. The other countries are demonstrating a steadily increase every year (Ferguson, 2011) (Table 1).

The high consumer acceptances in European and Asian market plus the sufficient areas of kiwifruit plantations in both Northern and Southern hemisphere have encouraged agro-food companies to invest in combining the northern and southern production in order to supply this seasonal fruit all year around. This has been possible because of a rather long shelf-life of kiwifruit (up to six months) (Chen,

2012), and by improving the logistics and communication among suppliers and chain players of both hemispheres. The local kiwifruit system has developed into a global dynamic industry.

One organization that has been taken part in this development is Zespri. Up to now, Zespri is the market leader in the commercialization of kiwifruit by managing more than 30% of the global traded volumes (Zespri, 2010). It sells Zespri labelled kiwifruit in more than 50 countries and the brand strategy of Zespri focuses on moving a perishable commodity fruit such as kiwifruit into the premium-priced consumer goods (Beverland, 2001). In-store sampling programmes, tailored promotions, TV commercials etc., have added significant value to the final product (Martin, 2008). Furthermore, the new Zespri Gold variety launched in 2000 has enhanced its success by providing the guaranteed quality and capacity of global supply in the supermarkets twelve months a year. Zespri has established partnerships contracts with 2,700 New Zealand growers and with more than 1,200 growers of other countries for satisfying the immense supply need (Zespri, 2010).

Among the major producers of the northern hemisphere, Italy supplies kiwifruit for Zespri from mid-October to mid-May (Chen, 2012). The strategic position within the EU and the leadership in exporting kiwifruit made this country very attractive to Zespri. Licensee contracts with Italian growers were established in 2000. Nevertheless, to guarantee the quantity needed, Zespri established contracts with a few Italian cooperatives that had the network of growers, the facilities to process kiwifruits, and all of those could connect and disseminate technical assistance to growers. These cooperatives were and are still the essential intermediary organizations that bridge Zespri International with Italian kiwifruit growers.

The interface between Zespri, cooperatives and kiwifruit growers present some peculiarities. Not only do cooperatives satisfy Zespri's demand with high quality kiwifruit (Zespri quality standards), but also have a parallel market where they sell and trade kiwifruit under their own label. Hence, they are supplier of Zespri but also direct competitors of kiwifruit suppliers for the EU retailers.

Beside these considerations, Italian kiwifruit growers are facing an overall increase in the world competition of kiwifruit production, which resulted in a decrease in the average price per kilogram. In the past eight years, the common Hayward kiwifruit price has fluctuated significantly between €0.8 kilogram and €0.3 kilogram. This made the market very uncertain and kiwifruit growers incapable of differentiating their products from the commodity quotations. An alternative is to valorise their kiwifruit by improving the quantity of high quality kiwifruit, and transforming Italian kiwifruit productions valued as a commodity into a premium product traded under the Zespri label (Alvarez & Shelman, 2010). In a competitive market where more and more countries are planting kiwifruit, the Zespri systems could be the way of increasing the price per kilogram through the quality valorisation and a consequent better return for the Italian growers.

In this study particular attention will be placed on the interface between Zespri, Italian cooperatives and growers and investigating in what way this system can be explored and/or improved. Through this master thesis we want to understand and analyse the Italian Zespri kiwifruit chain and to understand how growers' performance (farm productivity) are associated with other factors such as farm features, growers' attitudes, farm practices adopted and chain activities and interests. Thus the main objective is to understand how productivity of growers can be improved and what the opportunities for enhancing it are. Published literature reviews and interviews with a selected sample of Italian kiwifruit growers are conducted during this study in order to elucidate the phenomenon above described.

1.1 A view of the kiwifruit chain

Food Supply Chain (FSC) includes all organizations that deal with production and distribution of vegetable or animal-based products (Vorst, 2000). In particular, fresh vegetables, flowers and fruit all belong to this category. Principal actors of the FSC are: growers, auctions, wholesalers, importers and exporters, retailers and speciality shops (Figure 1). According to Vorst (2000) the aim of all of these food supply chain (FSC) phases is to *"leave the intrinsic characteristics of the product grown or produced in the countryside untouched"* (Vorst, 2000). The main processes are handling, storing, packing, transportation, and trading these foodstuffs.

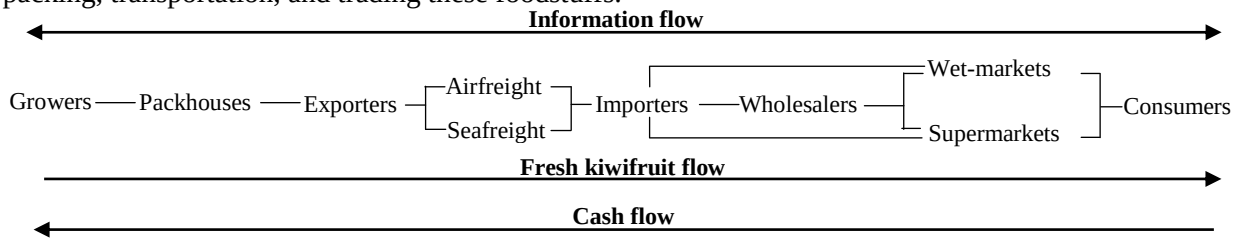

Figure 1: Kiwifruit supply chain.

1.2 Kiwifruit supply chain

Kiwifruit is one of those fruit globally traded in a cold chain (Chen, 2012) defined by Rodrigue and Notteboom (2011) as *"the transportation of temperature sensitive products along a supply chain through thermal and refrigerated packaging methods and the logistical planning to protect the integrity of these shipments"*. Within this category, kiwifruit has been categorized as exotic fruit such as pineapple, avocados, etc. which is normally stored at the temperature around 0 °C or higher (Arduino & Parola, 2010). The value generated downstream and the high-profile of kiwifruit justifies this attention in preserving kiwifruit from farm to plate (Smith, 2005). Chen (2012) highlights the fact that in each step of the chain special care is given to ensure the quality of the products and thus result in an optimization of the shelf life.

Figure 1 shows a kiwifruit chain. After harvesting, kiwifruit are immediately transported to packhouses where they are cooled down. Then grading, labelling and packing take place at ambient temperature, and immediately after those actions, kiwifruit are stored again in cooled rooms. Within this system there are several organizations or Kiwifruit Chain Players (KCPs), which are involved in producing, processing, distributing and commercializing kiwifruit. Starting from upstream there are: growers, cooperatives, traders (Zespri), distributors, importers and retailers.

1.2.1 Growers

Kiwifruit growers are located upstream in the chain and deal with all the activities aiming at transforming resources into kiwifruits. They manage fertilizers, pesticides, employees, orchards, machineries, capital and so on. The production and/or maintenance of the kiwifruit vines target at optimising both fruit number and fruit size per unit area of canopy (Patterson & Currie, 2010). Orchard Management Practices (OMPs) are the techniques and practices that enclose actions such as pruning, fertilizations, pest and disease management, harvesting etc. (Kilgour, et al., 2007). The cultural specific practices of combining the grower's skills, knowledge and commitment are fundamental prerequisite to maximize the productivity at the orchard.

Growers and cooperatives collaborate respectively. Whenever growers notify cooperatives about their vines status, forecasted volumes and other information to co-ordinate the logistic of the harvesting, cooperatives would furnish a series of services to growers in response.

1.2.2 Pack-house operators or cooperatives

The central activity of the operations during the post-harvest period is to preserve kiwifruit by packaging and storing. While at the orchard the quality of fruit is generated, the focus at the post-harvest operations is to preserve the quality by packing and storing. Refrigerated into cooperatives' infrastructures, harvested kiwifruit are immediately stored. Cooperatives' infrastructures include grading and packaging machineries, laboratories (quality assessment), shed and cold storages. The packaging takes place in the cooperatives or it is finished at the port of the importing countries when there are country-specific packaging requirements. Kiwifruit are often packed in carton trays of 3.3 kg and/or other type of boxes to preserve them from physical damages, favourite piling and transportation.

Cooperatives provide a range of services for the associated growers, for instance, technical assistance and documentation compliance (Pacino, et al., 2011). Seasonal themed meetings are often hosted and organized by cooperatives to encourage information exchange between growers and technicians. Training courses deliver knowledge such as farm risks, environmental issues, or new certifications for exporting. Economic analysis concerning market trends, customer response, operational costs are also transferred to growers as well as technical assistance about diseases diffusion, innovations, strategies to improve quality/yield, lowering the costs and reduce the environmental impact of the farming activity.

1.2.3 Traders

By continuing along the chain (Figure 1), traders are usually organizations that coordinate the import-export and sell batches of kiwifruit to supermarkets or wet-market. They manage the flow of kiwifruit and the cash flow. More or less of these organizations guarantee the transportation of kiwifruits, and in some cases, cooperatives behave as traders and have supply contracts with supermarkets which result in fewer passages within the chain. While in other cases more passages within the chain take place with the involvement of organizations such as exporters, importers, and wholesalers.

As discussed in Introduction, Zespri is one of the most crucial traders worldwide. Zespri ensures retailers with high quality kiwifruit all year long. It coordinates the whole flow of kiwifruit, the flow of money and information. To fulfil some activities, Zespri outsources transportations and other services to external companies, and also makes agreements with supermarkets. A further description of Zespri is given in the following sub-chapter.

Zespri

Zespri International Limited was funded in 1997 as a global marketing organisation, providing a Single Point of Entry (SPE) for the export of New Zealand grown kiwifruit (Zespri, 2012). The differentiation strategy based on promotion, new variety appeal, best kiwifruit quality and 12-months' supply has been achievable through its complex supply chain. The global distribution network from the producing countries to the consuming ones is controlled and guaranteed with more than 250 employees worldwide. Zespri commercializes more than 30% of the worldwide exported kiwifruit in over 50 countries. This has been possible by the co-ordination of kiwifruit, capital and information flow and by the strong of relationships with growers, cooperatives and consumers.

As we can see in Figure 2, Zespri has a centralized position in co-ordinating decisions within the chain. This co-ordination system is called *"helicopter perspective"* or *"supply chain cockpit"* for the reason

that one organization (in this case Zespri) takes the lead in the decision-making process as the supply chain director (Vorst, 2000). Centralised systems such as this one require that the chain director or leader make decisions along the chain and synchronizes the whole flow of goods, information and cash.

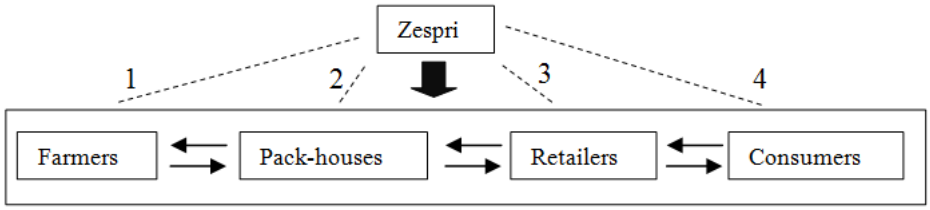

Figure 2: Zespri Supply Chain control.

In Figure 2, there is a schematization of the key relationships of how Zespri has close interactions with farmers, pack-houses, retailers and consumers. These relationships are reported in the following list:

1. Growers have licensee agreements/contracts with Zespri. They supply kiwifruit to Zespri and in return they get consistent payment for standardized (high quality) kiwifruit, as well as price stability along the years.
2. Pack-houses have contracts with Zespri. They carry out activities such as: quality control, labelling, packing and storing batches of kiwifruit until Zespri request to ship them.
3. Between Zespri and retailers there are contracts that guarantee the supply of kiwifruit.
4. Zespri has a marketing relationship with consumers. High quality kiwifruit, new varieties and promotional campaigns have created brand recognition.

The Italian Zespri system differs consistently from the New Zealand one. In Italy, Zespri guarantees its supply through fixed contracts mostly with cooperatives and growers. This is a medium term relationship based on contracts with suppliers. On the contrary, in New Zealand Zespri has several vertical integrations upstream in the chain, for instance, among growers and pack-houses and/or growers and Zespri. Some pack-houses own large plantation and some growers have shares of the pack-houses. Zespri itself was corporatized in 2000 and New Zealanders' growers are its primary shareholders (Martin, 2008; Alvarez & Shelman, 2010). As a consequence the New Zealand Zespri's chain presents closer interactions that cannot be compared with the Italian one.

1.2.4 Distribution centre

Continuing along the chain (Figure 1), after the trader there is the distribution centre. The intrinsic characteristics of the fruit and the way kiwifruit is traded determine the logistic structure adopted to distribute kiwifruit in the market. Such features are: distribution frequency and shelf life, shelf value, demand variability, market responsiveness and country-specific requirements (Chen, 2012). Those features are described as below.

- ***Distribution frequency and shelf life:*** the longer the shelf life of the product is, the more centralized the value added logistic services (VALS) and the lower the frequency of distributions is. In contrast, product with a shorter shelf life need that the VALS is located closer to the final markets and quick market respond increase the frequency of distribution.
- ***Shelf value:*** expensive fruit need more quality controls and attention to packaging. The more service level requested by the customers the higher is the margin earned.

- ***Demand variability:*** the more stable the demand is (banana, apple, etc.), the more centralized the distribution centre is (economy of scale). In contrast, products with unpredictable demand need decentralized distribution services that quickly respond to market changes.
- ***Market responsiveness flexibility:*** fast market respond requires decentralized distributors near the customers.
- ***Country-specific products or packaging requirements:*** national differences require customized packaging. So, for every market specific packaging is performed at the port or in the entry locations.

Those indicators together determine the location, the sort of distribution centre and value added logistic services (VALS). The long storability of kiwifruit (more than to six months) makes possible the adoption of a centralized distribution (economy of scale) (Chen, 2012), with less frequency of delivery. Also, the high shelf value of kiwifruit justifies the attention on packaging to prevent fruit loss and to add value by the use of packaging. As a result the location of the VALS is close to the harbour where kiwifruit are stored in a centralized area, eventually repacked and delivered to the retailers.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Italy												
New Zealand												
Chile												
Greece												

Table 2: Countries of origin and the respective supply in the European's market (Chen, 2012).

An example of distribution centre can be the harbour of Antwerp. Table 2 shows shipped kiwifruit to Antwerp from four main exporting countries (Belrose, 2011; Chen, 2012). In the EU the availability of kiwifruit all year long is only possible through the complementarity of these productions. New Zealand and Chile supply the EU market from May to October, whereas Italy and Greece provide kiwifruit for the rest of the year. Distribution facilities might be used all year long with diverse batches of kiwifruit. Centralized storage facilities store kiwifruit at controlled atmosphere and make possible the continue supply of kiwifruit into the distribution network.

1.2.5 Retailers and consumers

Once kiwifruit arrive at the retailers, they are unloaded and moved into the shop storage room. Trays of kiwifruit are then placed in the shelf. At the retail level, the shelf life of the fruit on display depends on the maturity level, however when exposed at room temperature kiwifruit ripens after a few days to a week. The supply is guaranteed by contracts with suppliers such as wholesalers, cooperatives, traders, and importers.

In the supermarket section of fresh fruit and vegetables, large space is given to important products daily consumed e.g. apples, carrots, bananas, potatoes, oranges, etc. (Martin, 2008), and kiwifruit is often located in a smaller part of the fruit section where it competes against other tropical fruits. An example concerning the shelf space in the supermarkets was experienced in Japan and in the UK. Significant effort was placed in negotiating shelf space for both the Zespri™Green and Zespri™Gold products (Martin, 2008). Although some resistances, when new kiwifruit variety Zespri™Gold was launched, consumers demonstrated a certain neophilia which result in a willingness-to-pay premium for it; often there is 100% more than that for the traditional Hayward kiwifruit (Ferguson, 2011). Hence, retailers have shown an increasing interest in selling kiwifruit and the new varieties/products that could give them an exclusive position over competitors and generate excitement among consumers (O'Rourke, 2011).

2 Research design

After having described the kiwifruit chain players and the functions they perform within the chain, in this section we move our attention to the aim of this study through. The conceptual design phase includes the concepts that we focus on, and in the technical design we will explain how we intend to achieve them.

2.1 Conceptual design

2.1.1 Problem context

The problem context is divided into sub-sections elaborating reasons why we intend to focus this study on Italian kiwifruit growers and on their productivity. The first sub-section refers to the national productions comparison between Italy and New Zealand. Then, we will explain which are the reasons that motivate us in focussing on growers and why do they play a crucial role within the chain. Lastly, we refer to the productivity at the orchard level and we will refer to the scarce collaboration within the Italian kiwifruit industry.

National productions

When comparing the Italian and New Zealand kiwifruit national productions of the last ten years, there are clear differences that highlight how the productivity per hectare differs (Belrose, 2011). Figure 3 and 4 show the production per thousand hectares of kiwifruit cultivations in New Zealand and Italy respectively. The diverse tendencies show that the New Zealand kiwifruit industry has been increasing the volumes via the existing optimized plantations through higher yields per hectares. On the contrary, Italy has shown a growth in volumes produced via introducing new cultivated areas. While Italy shows significant fluctuations of the national volumes, New Zealand presents a rather stable trend.

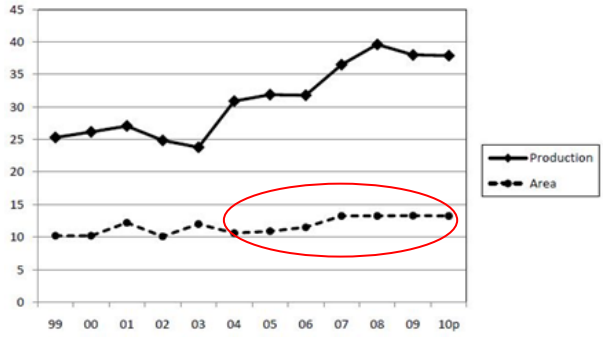

Figure 3: New Zealand kiwifruit area and production, 1999-2010 (1,000 hectares and 10,000 metric tons) (Belrose, 2011).

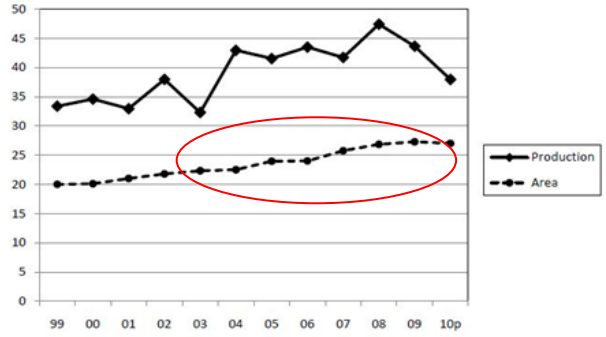

Figure 4: Italian kiwifruit area and production, 1999-2010 (1,000 hectares and 10,000 metric tons) (Belrose, 2011).

The above finding validates the first ineffectiveness of the Italian kiwifruit industry appears when comparing these two countries kiwifruit industries national production and plantations. Thus understanding whether these productivity differences are rooted on the climate and soil conditions, growers' orchard management and/or are related to less collaboration within the chain is in our interest.

Why focusing on the farm level

The second reason that stimulates our attention and explicates why we intend to focus our study on kiwifruit growers will be given here. Figure 5 presents three adding value phases: 1) the orchard level,

2) at the post-harvest operator, and 3) the exporter level, and summarizes main activities taken place during those three phases.

The first value generating activity is at the producer level, where growers take care of the kiwifruit plants during the growing season. Here the intrinsic characteristics of the final product are determined through the OMPs.

The second value generating activity is at the post-harvest operator level (pack-house, cooperatives). Here, kiwifruit are graded, packed and stored. The grading operation makes possible the division in product groups which satisfy specific markets and customers (Kilgour, et al., 2007).

Lastly, traders, exporters carry marketing actions intended to build brand equity and stimulating consumers' demand around the world (Zespri, 2011) and add a further value to the product. Zespri is one example the demonstrates how through these marketing actions it has moved a perishable commodity (kiwifruit) into a premium-priced consumer goods (Beverland, 2001).

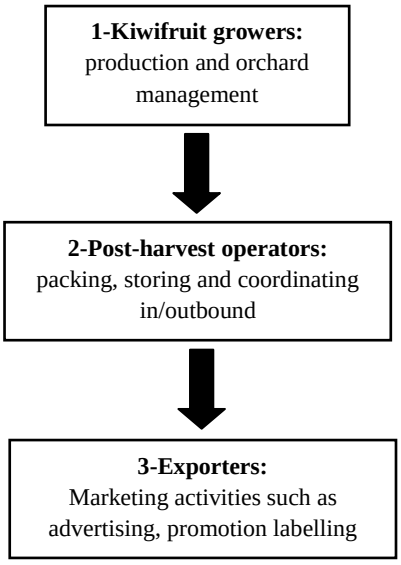

Figure 5: three value generating activities of the kiwifruit chain.

Belrose (2006) stated that *"The **potential value is determined initially by the producer in the orchard** during the life of the kiwifruit plant and each year during the growing season. That effort is either confirmed or weakened by the care with which the product is harvested. **Whatever quality exist** when the fruit leaves the orchard can at best be maintained by each subsequent packer, storage or handling operation. **It can rarely be improved much**"*. According to Belrose (2006), kiwifruit growers are the only ones that determine the intrinsic quality of the final product, such as taste, shape, size, colour, sugar content and so on.

Starting the chain with high quality products result in less wastage and more effectiveness in the following stages. According to Belrose (2006), ***quality can only be maintained and rarely can be improved*** along the chain. In accordance with the aforementioned considerations, we intend to give particular attentions to kiwifruit growers in this study. We see growers as crucial players of the kiwifruit chain because they determine the intrinsic characteristics of the final product.

Italian growers productivity

The third reason originates in the Italian historic productions. As it has been discussed the kiwifruit orchard productivity is the result of a delicate equilibrium between quality and quantity, and only through good farm management practices its optimization is possible (Patterson & Currie, 2010). Orchard Management Practices (OMPs) are the techniques and practices that enclose activities such as pruning, fertilizations, pest and disease management, harvesting etc. (Kilgour, et al., 2007). The implementation of the optimal cultural practices on the particular characteristics of the grower's soil, orchard, area and climate are fundamental prerequisites to maximize the productivity and can increase grower returns over the lifetime. Besides, kiwifruit grower's skills, knowledge and commitment influence his/her orchard and are crucially linked with the productivity.

Although there might be several factors affecting the growth of kiwifruit vines such as seasonal influences and so on, it has been showed in New Zealand, that by the integration of a range of vine

manipulation techniques or OMPs that top performing growers constantly achieve very high fruit productivity over several seasons (Woodward & Patterson, 2008; 2009). Therefore, we consider kiwifruit growers' skills and commitment as important factors influencing the outcomes of the orchard.

Furthermore, major constraints have been found in the Italian kiwifruit chain. The productivity of Italian growers often lacks in quality and quantity. Italian growers have been focusing primarily on the total yield of their crop rather than fruit size or quality or on class 1 yield per hectare (Mazzeo, *et al.*, 2011). This growers' careless penalizes the final price per kilogram and therefore their gross revenues.

By taking into account these considerations, it is interesting to understand which are the causes affecting Italian kiwifruit growers. Whether they know these OMPs and how they implement them, and also whether they focus on quality and/or quantity. This study intends to understand to what extent Italian Kiwifruit growers are committed to this business. As a result, our objective is to understand what factors are affecting Italian growers' productivity.

Chain reasons

Growers' productivity depends on several factors of the farm management and of OMPs implementation, nevertheless, chain organizations such as cooperatives, Zespri, suppliers of agricultural products, research institute and public organizations do influence them to a certain extend by providing technical support and services.

Within the Italian system there is a high level of competition among kiwifruit cooperatives, processors and exporters. There are several large companies that dominate the export with consistent volumes but also a multitude of traders that buy kiwifruit directly from growers. Hence, the whole industry is characterized by different sorts of collaboration, short term relationships between growers and buyers, and different quality parameters that differ from buyer to buyer. The cohesiveness of the chain players reflects lack of trust and confidence. From the growers side there is a doubtful trust in the cooperatives and in the traders.

From the Zespri perspective emerged that *"securing the right product (in terms of quality) has been more than a challenge"*, and that they *"have to deliver consistent, high quality and safe fruit that upholds the integrity of the Zespri brand"* (Lain Jager, Zespri CEO) (Alvarez & Shelman, 2010). This also reflects the interest for Zespri to understand how productivity in terms of quality can be improved in the Italian sector.

The other reason that justifies the importance of the chain players in influencing growers' productivity is the technical assistance and services provided. Growers have to adapt rapidly to market, regulations, and environmental changes, which makes interactions within the chain crucial. The transparency of the information concerning market trend, price forecast, new technologies and development can only be achieved through the collaboration between Kiwifruit Chain Players (KCPs). If we consider the concept of supply chain management (SCM), the design of seamless value-added processes is realized *across the organizations boundaries* and not individually. This justifies the reason why we intend to include these organizations surrounding the growers which might exert an impact as well but it is not yet clear.

The last reason reflects the potentiality for Italian kiwifruit producers. The climate suitability and the strategic position within the EU make this country first among the major exporters of kiwifruit

(Belrose, 2011). This also reflect significant interests for a global trader such as Zespri which requires high quality kiwifruit to explore new markets.

In this study we aim on understanding the type of interaction among these chain players and whether they jointly collaborate in optimizing the Italian kiwifruit production and commercialization. In particular, our intention is to understand: first, to what extend the productivity of Italian growers is correlated to activities and interests of chain actors, such as cooperatives and Zespri; and second, which correlations there are between orchard management, technical practices, chain actors' activities and interests, and growers' productivity.

Concluding remarks of the problem context

As mentioned above, we have drawn our attention to the necessity to understand and the attempt to promote development within the Italian kiwifruit chain by focussing on growers and their interaction with chain players. In summary, the motivations that justify the objective of this study are:

- The productivity of the Italian can be improved if compared with the New Zealand one.
- The growers are crucial chain players which determine the intrinsic quality of the final product.
- In Italy, growers have been focusing on quantity rather than quality. OMPs are crucial items to improve the situation and how they are implemented is the objective of this study.
- The lack of collaboration among the chain players is related to the lack of trust and effectiveness within this system.
- Zespri requires high quality kiwifruit to guarantee the integrity of the Zespri brand and explore new markets.
- Lastly, the potentialities of the Italian productions place this country as an important player within the worldwide kiwifruit industry.

2.1.2 Conceptual framework

The conceptual framework shown in Figure 6 summarizes several concepts that were identified during the contextual analysis. In the left boxes, there are two main areas containing factors that we identified as fundamentals in influencing growers' productivity.

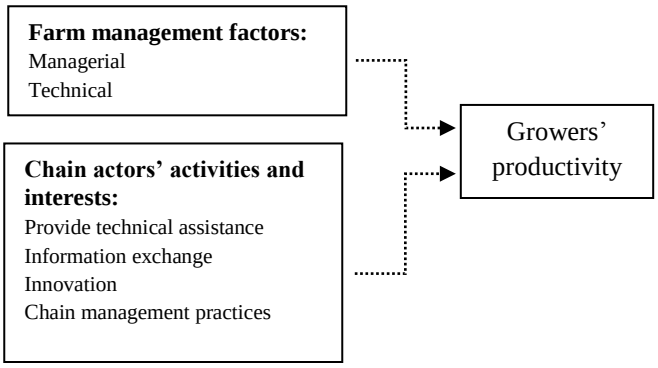

Figure 6: Factors that influence farm performance.

In the farm management factors box there are managerial activities and technical practices that growers adopt in their orchard. The managerial aspects include growers' skills, knowledge, commitment and experience; whereas technical factors are the farm technical practices. Both are correlated with growers' productivity.

In the second box, chain actors' activities and interests denotes a set of factors that probably have an interaction with growers and therefore influence the productivity too. These factors are: technical assistance, information exchange, diffusion of innovations, and chain management practices. These two main areas of study set the boundaries of the research.

2.1.3 Research objective

With a clear picture of the problem context and the definition of the research background, the research objective of the study is:

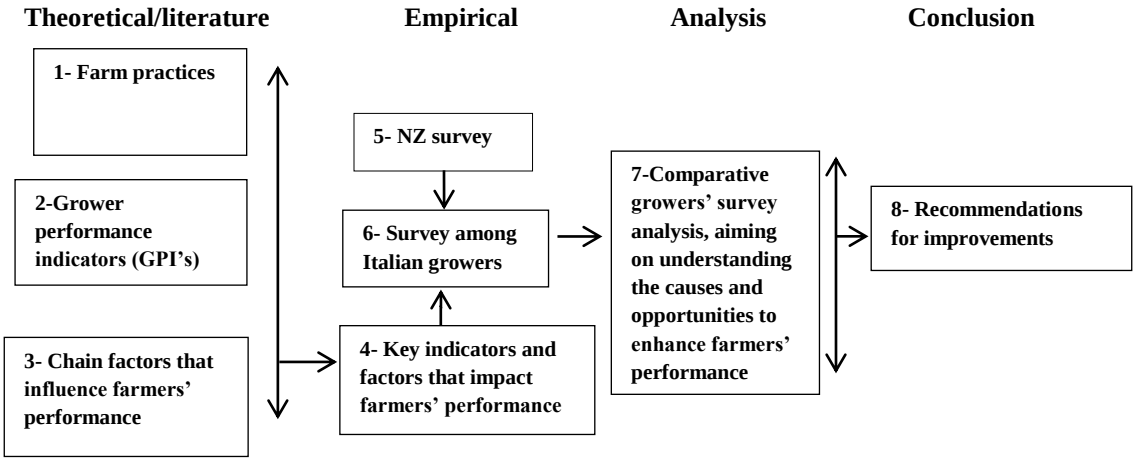

Figure 7: Research framework.

"To provide recommendations on opportunities for productivity improvements of the Italian Zespri kiwifruit chain by investigating how farm management practices and chain players related activities have positive or negative affect on growers' performance".

2.1.4 Research framework

The research framework illustrated in Figure 7 is a visual representation of steps that should be taken to accomplish the research objective.

A theoretical/literature review will be conducted on different fields (Figure 7, bullet 1, 2, 3). Theories concerning farm management theories (1) will be used to understand the basis of the kiwifruit orchard management. Grower performance indicators (2) will be identified from the literature as for measuring farm productivity. Lastly, particular attention will be given to the literature concerning chain factors influencing growers' performance (3).

In the second phase, an empirical analysis will gain direct information from the Italian kiwifruit growers. From the literature study, a set of key indicators will be selected (4) and converted into variables and questions which will be adopted as part of the questionnaire. The design of the questionnaire will be supported by referencing other surveys already held in New Zealand (5), and then the questionnaire will be sent to Italian kiwifruit growers. The data collection will also take place in this phase of the study (6).

Then, the information from the survey will be processed with statistical software (SPSS) and the possible correlations among indicators will identify what are the factors influencing growers' productivity (7). Conclusions will be drawn then with the recommendations for improvements (8).

2.1.5 Research question

Central question

"What opportunities can be recognized within the Italian kiwifruit chain to improve the growers' productivity?"

2.1.6 Definition of concepts

In this section, key concepts will be provided to facilitate the execution and the delineation of the research domain. Additional restrictions for some concepts should be imposed in order to proportionate the scope of this research project.

OMPs

Orchard Management Practices (OMPs) are the activities and practices that optimize the kiwifruit productivity in the kiwifruit orchards. A high portion of literature concerning OMPs will be yielded from New Zealand professional and scientific journals due to the great advancements in research and in kiwifruit orchard optimization.

Growers' performance

Among the possible key performance indicators (KPIs) which can be applied to measure the performance kiwifruit farms, we will use quality and quantity as growers' performance indicators.

- **Quality:** it measures whether or not the product meets the customer expectations/requirements. E.g. taste, colour, sugar level etc.
- **Productivity:** is related to the outputs generated by the farming activity in relation of the resourced consumed by it. Usually it is expressed as a ratio (actual output/actual input). E.g. tonnes of kiwifruit produced per hectare/hours of labour.

Quality

The quality of kiwifruit is evaluated by diverse indexes. There are two commonly used indicators: fruit size and dry matter. According to Cai (2011), kiwifruit size and taste significantly increase the market acceptance when the fruit is bigger and tastier.

Kiwifruit size denotes the physical appearance of the fruit. It is determined by the number of fruit that fits in one tray of 3.3 kg. Sizes that are commercially marketable vary between 18 (183g) to 42 (78g) (Kiwiflier, 2011). On the other hand, kiwifruit dry matter (DM) is considered as the most suitable index for measuring organoleptic proprieties. DM includes both soluble solids (mainly sugar) and insoluble solids (structural carbohydrates and starch) that affect the taste of kiwifruit (Crisosto, et al., 2011). Tests conducted on consumers' acceptance of kiwifruit showed that fruit with a low DM are less preferred, and that DM higher than 16.1% was considered sufficient for the Hayward and around 18.5% for Zespri Gold (Crisosto, et al., 2011). DM has been considered to be a potential index for taste and for storability; therefore, Zespri pays additional incentives to the growers who supply premium tasting kiwifruit (Patterson & Currie, 2010; Zespri, 2010; Kiwiflier, 2011). The enrichment of the DM is the result of the carbohydrate accumulation influenced by orchard management practices and their execution has become a fundamental prerequisite to be profitable.

Productivity

Farm productivity depends on quantity and quality harvested. It is expressed as the "yield of class 1 fruit per canopy hectare", and it is measured in trays per hectare (3.3 kg/tray) or more commonly in tons per hectare (tons/ha) (Patterson & Currie, 2010). The average yield of one hectare of Hayward kiwifruit varies between 30 to 55 tons/ha, while for the Zespri Gold variety it varies between 30 to over 70 tons/ha of class 1 (Patterson & Currie, 2010).

The productivity of the orchard is measured via the profitability, which is the result of multiplying the quantity and the quality produced. One of the key indexes of measurement is the orchard gate return (OGR) (Kilgour, et al., 2007). The OGR is the amount of money that the grower gets as a

remuneration, and it is defined as the total amount of € or $ paid to the grower for one season per canopy hectare (€ or $/ha/year). The OGR does not only measure the economical return of the growers but also reflects multiple factors. The OGR includes the normal fruit payment per each category produced plus the incentives received for the quality achieved. In Table 3 there is a scenario of the average OGR of New Zealand growers. The data has been taken from the Zespri monthly magazine called Kiwiflier of October 2011.

Fruit categories	Average OGR per hectare
Zespri Green	$30,828
Zespri Green Organic	$34,671
Zespri Gold variety	$85,227

Table 3: New Zealand growers average OGR of for three categories of kiwifruit 2010/11 (Kiwiflier, 2011).

Concerning this research the OGR will be used as the performance indicator to assess the effectiveness of kiwifruit farmers. It includes several variables e.g. quality parameters, productivity (yield per hectare) in one numeral index, so this facilitates the whole investigation and directly reflects the ability of the growers in implementing agricultural practices aiming on its increase. Furthermore, through the OGR we can distinguish from the pool of kiwifruit growers and, productivity differences; and then to categorize the best-in-class and the low-skilled growers.

2.2 Technical design

2.2.1 Research strategies

A desk research will be integrated with a survey methodology. Where the desk research will yield concepts and theories of kiwifruit cultivation methods and chain management practices, the direct investigation among Italian growers will be conducted through a survey.

Desk research

The foundations of the study project are based on a desk research. Investigation on existing materials such as literature, secondary data and statistical analysis concerning kiwifruit industry and chain factors will give diverse perspective of the issue.

Particular attention will be given to New Zealand literature for the large availability of material published, but also for the long leadership that this country has shown in the kiwifruit research. The large material published cover multiple aspects of the kiwifruit industry starting with the practices related with farm management and orchard optimization, passing through logistic and export and marketing analysis of consumer preferences.

Theories and concepts of kiwifruit farm management and farm performance. An in depth review of the published articles concerning kiwifruit orchard management practices, optimization of the resources, quality improvements etc. will be carried out at this stage. Attention will be also given to literature concerning kiwifruit chain members (in this case by referring to the Italian case), their interactions and the indicators previously used in other surveys.

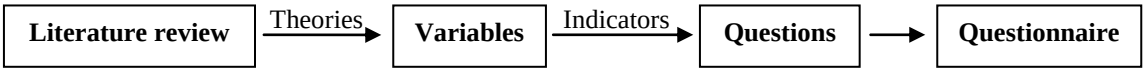

Figure 8: Questionnaire design methodology.

This will lead to the basis for the delineation of a set of variables which will be later converted into questions. In other words, the objective of the desk research is to investigate what are in the literature

and a set of variables will be selected based on those concepts and theories, and then converted into questionnaire questions (Figure 8).

Survey

The survey approach used in this study will investigate on the Italian growers (research unit). The target is to obtain more knowledge about the Italian's growers, to figure out what are the elements that affect their productivity, and to see whether those elements are related to growers' lack of knowledge, commitment, and/or are related to chain players' factors.

To obtain reliable results, at least 60-70 growers should answer the questionnaire. Thus, this stage entails a large number of research units and an intensive workload to collect and process the data collected. The questionnaire will be filled in online and we will visit the farm and complete the questionnaire in person when needed. The content of the questionnaire will be based on what discussed above and on the literature review, however, the principal group of questions will be focusing on farm characteristics, farm management, technical practices, collaboration with chain members and farm performance and personal opinions. Also, questions about the interface between Zespri and cooperatives, and the satisfaction of Zespri's services will be included. Meanwhile, we also want to investigate whether growers are aware of the cultural practices/techniques and whether they implement them.

Finally, data acquired from the survey will be processed with SPSS. Statistical correlations and other type of analysis of the above-discussed factors will elucidate the issue. This information is essential in understanding the circumstances surrounding the work at the farms, their experiences and relationships with cooperatives and Zespri.

3 Literature review

3.1 Introduction

In this section, attention will be placed on literature concerning farm management practices, technical practices concerning the cultivation of kiwifruit and theories regarding chain factors that influence the modus operandi of kiwifruit growers (conceptual model Figure 6).

Starting with some aspects of the farm management and farm practices we will address determinant elements of the kiwifruit farming system. Particular attention will be paid to the type of farming system, the farm management team, how decision are taken within the team and whether the farm is family-owned, managed, and/or it is run under diverse form of ownerships. Education, experience and the type of labour used are other elements that we will take into account.

In the second part, a general explanation the orchard management practices (OMPs) will be clarified. Consideration of the kiwifruit cultivation concerning the main practices of canopy management, pollination, soil, water, and pest and diseases management will be elucidated.

After that, we will address the kiwifruit chain actors' activities and interests. Here the focus is on the importance of technical support given to the farmers, for instance, how it is given, from which organizations of the chain, and how the information are shared and disseminate among kiwifruit chain players (KCPs). The transparency within the whole system is of crucial importance for the development; therefore, one sub-chapter is dedicated to the information transparency. Then, we will explain some theories concerning the innovation in agriculture and the innovation in the kiwifruit sector. And in the last part of the literature review, chain management practices will be elucidated.

The main material used in this section often refers to the New Zealand kiwifruit industry. The importance of this crop for the national economy is reflected in the number of studies concerning cultivating, distributing and commercializing kiwifruit. Thus, particular attention will be placed on New Zealand academic and professional journals and publications. Besides, we will also cite agriculture related articles concerning kiwifruit, agriculture in general and on food chain.

3.2 Farm management practices

3.2.1 Farming system

Zespri has been commercializing three main fruit products Zespri™Gold, Zespri™Green and Zespri™Green Organic. For each fruit category, there are specific production processes and farm systems. One study on the three different systems conducted in New Zealand presents that Zespri™Green growers showed significant interests towards fruit yield and quality, orchard gate return (OGR), Zespri activities, climate and vine health. Meanwhile, Zespri™Gold orchardists shared the same view of the Green one, although, they showed more concern on quality achievement at the orchard level and the maintenance along the chain (postharvest operators). Zespri™Green Organic growers demonstrate to have similar concerns on yield and quality; however, they emphasize the aspect of soil fertility influencing their yield and quality. They also demonstrate satisfaction in their orchard environment as a place to live and to bring up a family (Fairweather, et al., 2009).

In each farming systems growers have developed different skills and peculiarities in organizing and managing their kiwifruit orchards. Zespri Gold growers are usually more skilled in managing the canopy, applying fertilizers and tend to hire and rely on skilled labour. High profits generated with this variety justify additional cultural practices to balance the quality and yield throughout carful pruning

practices. Organic growers tend to be very skilled in managing the soil fertility and limiting pesticides and fertilizers as well as conserving the biodiversity of their orchards. To generate good returns, they use alternative approaches/techniques and the support of orchard consultants (e.g. fertilizers advisors) (Kiwifruit Journal, 2009). Lastly, Green growers showed to be less educated than Zespri Gold and Organic growers (Fairweather, et al., 2007). The lower profitability of this crop justifies why less labour hours are used to produce green kiwi.

Although, for each production system the price differs with consequent distinctions in the OGR, large profit gaps between the best and the worst farmer are seen in past data. The results may depend on technical, agricultural and managerial aspects of the farm, as well as characteristics of the soil and of the orchard.

3.2.2 The farm size and the management

Basically, within the kiwifruit industry we can distinguish three sorts of farm based on the plantation size: large plantation, medium plantation and small farms. Farm size characteristics are also often reflected in the way farms are managed.

Large plantations

Large plantations (>30 ha) have got permanent skilled workers and a management team composed with managers, supervisors, experts and technicians. Decisions are jointly taken in the management team which plans and coordinates necessary actions. Large plantation's managers have close relationships with post-harvest operators and suppliers. These farms often achieve high production due to the high efficiency and innovativeness. Furthermore, large plantation farms are often subdivided into operations units. The economy of scale and the capacity to retain skilled workers enhance their efficiency and effectiveness which make this business attracted to external investors. Often the land and the orchard are collectively owned and/or leased.

Medium size plantations

Medium size plantations are generally around 10-30 ha and possess similar features of the large ones but with some differences. The management team is less structured. Experts do not work on farms full-time and often this sort of farm is family-owned. Decisions are made on the experiences of the growers and family members. Family members work full-time and the presences of children also boost the family members' participation. Reasonable incomes make attractive this business for children and for other family members (Corsi & Salvioni, 2012). The land is often owned but there are also cases where it is leased. They usually have a group of specialized workers that holds crucial operations and when needed they recruit seasonal labours (harvesting period). The innovation adoption is still very high. In several cases, medium size plantation farms present very dynamic attitudes, participation to initiatives, and sharing opinions with peers and technicians. Thus, even though they can be family-owned, they are very competitive within the industry.

Small farms

A large percentage of existing farms is the small farms. In this group, there are smaller family owned plantations of 1 to 10 hectares, and farm operators are mainly family members. They work full-time (on-farm labour) and/or part-time (off-farm) (Corsi & Salvioni, 2012). They have few permanent workers that carry out the main practices along the year and the farmer is the only referent person who manages all the resources. During the picking time, they recruit extra workers. Concerning the innovation, this sort of farm presents some resistance in implementing novelties due to the limited time

and financial resources. Decisions are often taken by the farmers, and in more dynamic cases, in consultation with technicians of the cooperatives and/or Zespri.

Considerations

As we also discussed in the previous chapter, there are huge productivity gaps in each farm management category. Even very small farms can achieve excellent outcomes. Especially when family members are really committed and skilled or even have agricultural degree, the quality of their labour justifies the results. This highlights the fact that although farm size might affect innovation adoption and investments, it is not always true that bigger farms realize better results. It is the combination of multiple intrinsic and extrinsic factors of the farm and of the grower (manager) that implemented in the right way can give superior results. The intent of this research is also to understand how this aspect is correlated with chain players' influence and participation.

3.2.3 Growers education

Farmers' education and training are fundamental to rapidly adapt their businesses to any type of changes (Millar & Kilpatrick, 2005). Often growers see educational institutions with fear, and formal education qualifications are not highly valued. Other barriers that have been identified by Millar and Kilpatrick (2005) are the lack of confidence as a learner and often the courses are perceived as not meeting farmers' real needs. There may be knowledge barriers between scientist and growers that impede the cooperation between growers and scientists.

Kilpatrick (2000) investigated how education and training measures affect agricultural and land management among Australian farmers. In the study, emphasis is placed on the relationship between the education of growers (below secondary school, secondary school or post-secondary school) and their participation in education and training classes (including courses, seminars, conferences and field days). Kilpatrick (2000) concluded that *"education and training is able to influence change in three broadly defined ways: first, by delivering new knowledge and skills; second, by providing interaction with 'experts' (facilitators, trainers or teachers); and third, by providing opportunities for interaction with peers (fellow training participants)"* (Kilpatrick, 2000).

In the Costa Rica coffee industry, only growers that were generally more experienced and educated were able to transform their cultivation management practices in a more efficient coffee production. Coffee growers increased their coffee quality and shifted from a commodity system characterized by low cost production and low price to a high quality coffee meeting the emerging customer demand patterns willing to pay a premiums price for it (Wollni & Brümmer, 2012). Corsi and Salvioni (2012) refers that higher educational levels may rise the productivity of farm work as well as broaden the range of job opportunities which would lead to more off-farm participation.

Interesting data concerning differences in qualification within the New Zealand kiwifruit industry was shown in a study by AGROS (Agriculture Research Group on Sustainability). 40% of the Organic producers had a diploma or a certificate whereas only 29% of conventional Zespri Gold growers and 17% of conventional Green growers have such equivalent condition. Concerning the university degree, 17% of Zespri Gold growers achieved agricultural or horticultural degree, while 13% of Organic growers and only 2% of the Green growers had a university degree (Fairweather, et al., 2007). This shows how Organic and Zespri Gold kiwifruit growers tend to be more educated than the green farmers.

3.2.4 Experiences in the fields

The level of experience is also a very important determinant that affects farmers' performance. Agricultural practices and techniques have always been transmitted from generation to generation. The experience of the growers is a valuable source of knowledge that must be taken into account when considering the grower's education. The growers' attachment and familiarity with their ecosystem (land, vines, climate, etc.) and the experiences made by mistaken fertilization, and/or other agricultural practices are valuable variables that influence growers' performance. However, although years of experience can be seen as a positive factor, it is not always the case. For instance, when the new Zespri Gold variety was launched in Italy in 2000/2002, a large majority of the Italian growers applied the same agricultural practices already experienced for years on the Green one; but as a result, a considerable number of them mistaken fertilization, pollination, fruit load etc. They did not consider the different characteristics of the plant and showed a reluctant behaviour in learning new techniques.

3.2.5 Type of labour: seasonal or fixed employees

The required labour to manage kiwifruit vines in specific periods of the year highlights the strong reliance of kiwifruit growers on the workforce. Skilled employees combined with seasonal workers hold most of the hand labour required in the kiwifruit farm. The variable cost of the labour needed for 1 kg of kiwifruit harvested represents the biggest expenditure and in relation to the variety cultivated, the growing system (plant density, etc.) the hours of labour required for one-year production are between 600 and 1200 per hectare. For instance, labours for only fruit and flower thinning can be expensive since it is a time-consuming work. The work takes from 100 to 200 hours per hectare (Brun, 2010).

Specialized workers are needed for winter and summer pruning, cane selection, flowers and fruit thinning, till the soil and apply pesticides. For instance, concerning winter pruning and other crucial activities, Patterson and Currie (2010) remarked how the key feature of many high productivity orchards is an "intensive" approach which use *"skilled labour to implement pruning practices, and close attention is paid on achieving target numbers of winter buds and final fruit numbers per unit canopy area that enable fruit size expectations to be met"*. Thus, in order to achieve high results, it is very important that people are trained and have enough experience to correctly manipulate the kiwifruit vines.

Nevertheless, during picking time, kiwifruit growers need to hire seasonal workforces which are often foreigners and temporary emigrants. These temporary workers receive minimum remuneration and usually stay for a limited amount of time. In New Zealand, growers and post-harvest operators hire foreign workers to supplement their workforce over the peak periods such as harvesting time (Max, 2008). Even if the extra workers stay for just a few weeks of the picking time, growers offer training lessons concerning picking practices and practices to avoid physical damages caused by poor picking practices. This enhances a reduction of fruit loss and the optimization of the orchard profitability (Woodward & Allison, 2009).

3.3 Farm practices

In this section, literature concerning kiwifruit orchard practices and why they are so important in determining growers' productivity will be elucidated. The execution of a series of correct actions such as canopy management, pollination, nutrition, irrigation, pest and disease management are crucial in guaranteeing the financial returns of the growers. Crop load in terms of fruit number, size and quality

per hectare of canopy is the result of the combination and execution of all these activities (Patterson & Currie, 2010). Differences in terms of soil, climate, vines age, cultivar, and so on are key determinants characteristics of the kiwifruit plantation and they differ from farm to farm, and often even within the same orchard. However, the techniques for implementation described here have been proved to be the most influential factor influencing the productivity.

3.3.1 Canopy management and structure

Canopy management or vine manipulation is crucial in determining the number of fruit per m² of canopy, fruit size and dry matter content (DM) (Patterson & Currie, 2010). Canopy structure, winter and spring pruning, wood selection practices are all implemented to have an appropriate ratio of leafs/fruits, interception of light and to maximize the portioning of carbohydrate to the fruit rather than into vegetation.

The interception of light is determined by the leaf area index (LAI). Its optimization is guaranteed through a prudent selection of the wood (canes) during winter pruning (Patterson & Currie, 2010) and it is fundamental to optimize the production of carbohydrates. A high productivity Hayward orchard would typically have LAI values of 3-4 (Patterson & Currie, 2010). The optimum LAI via wood selection seems to be far more important to a high productivity outcome than previously appreciated (Patterson & Currie, 2010). The ratio of leafs/fruit is crucial for an optimal growth of fruit and the accumulation of carbohydrates per fruit (Patterson & Currie, 2010)

Pruning and crop load

Kiwifruit vine has many sources of carbohydrate and many carbohydrate sinks (Minchin, et al., 2010). Researchers have been showing that carbohydrates are allocated with different priority in diverse organs of the plant. The competition for carbohydrate partitioning between shoot apices and fruit has been proved to affect the final size of kiwifruit by Minchin et al. (2010). The research has showed that when shoots are pruned the regrowth has a negative impact on fruit development. Size and DM appear to be affected when fruit are harvested (Minchin, et al., 2010). To prevent this competition, growers have to minimize the spring and summer pruning and/or better implement specific pruning techniques (Patterson & Currie, 2010). Gel-pruning, tip-squeezing, "Zero-leaf" pruning and low vigour wood can minimize this effect.

- **Gel-Pruning:** shoots are cut with a gel containing naphthalene acetic acid (NAA) which is applied to limit the regrowth.
- **Tip-Squeezing:** aims on causing a "control crushing" of shoot tips which are consequently inhibited to regrowth. By squeezing the tips also the development of new lateral shoots is inhibited (Patterson & Currie, 2010).
- **"Zero-leaf" pruning:** consists in pruning the fruit shoots just after the last fruit. In this way there are not buds which can regrowth.
- **Use of "low-vigour" wood:** it is a canopy management technique aiming on using canes which have already fruited and which have a low propensity for vigour shoot growth (Patterson & Currie, 2010).

Lastly, fruit thinning is required to balance the crop load and enhance the quality. Moreover, the homogeneous distribution of leaves, shoots and fruits, enhanced light penetration and air movement result in a better pest and disease control (Matta, et al., 1987). The selection of less vigour type of wood as well as the maintenance of the canopy through the adoption of vegetation practices

aforementioned have become essential for high productivity results (Patterson & Currie, 2010; Miller, et al., 2001; Thorp, et al., 2011).

3.3.2 Pollination

Kiwifruit is a deciduous species and male pollinators must grow together with female to have fruit set (Costa, et al., 1993). Usually 10% to 25% of the canopy area is given to male plants with a ratio male/female that vary from 1:4 to 1:7 (Patterson & Currie, 2010). Kiwifruit blooming lasts 10-15 days and the contemporary opening of male and female flowers is essential for fruit set. Even so, few days of adverse weather condition during the flowering period can seriously compromise the pollination and the achievement of commercial size fruit (Gonzales, et al., 1998; Costa, 2003).

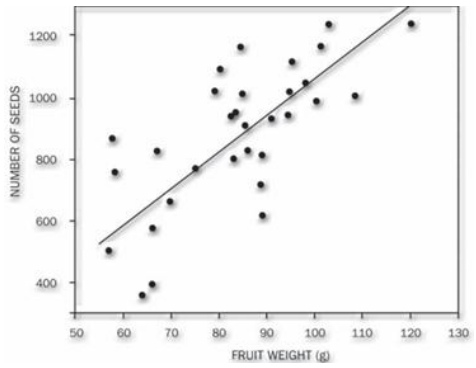

Figure 9: Relationship fruit weights and seeds number (Goodwin, 2000).

The direct correlation between fruit seed number and the fruit size has been documented by several studies (Gonzales, et al., 1998; Costa, 2003; Testolin, 1991). Within the female flower there are up to 1500 ovules (Hopping & Jerram, 1979) and their fecundation is essential for good weight fruit. An overall number of 1000 seeds are needed to harvest fruit >100 g (Costa, et al., 1993; Testolin, 1991). Figure 9 shows the relationship between fruit weight and the number of seeds they contain (Goodwin, 2000). Although there is not a linear correlation, it is clear how seed number can influence fruit weight.

3.3.3 Pollination methods

Male pollen is naturally transported to the female flowers by wind and insects or it can be transported by artificial pollination. Previous studies documented outcomes of each pollination method in terms of advantages on fruit size, working hours needed and possible limitations in case of adverse climatic conditions (Costa, et al., 1993; Gonzales, et al., 1998; Asteggiano, et al., 2010). Figure 10 compares fruit weights/frequency at the harvest time pollinated with three diverse methods (Costa, et al., 1993). Results demonstrate smaller fruit in the control when compared with honeybees and hand-pollinated fruits.

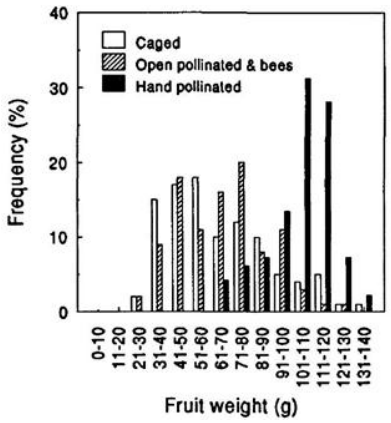

Figure 10: 10-g class distribution of fruit weight in caged, open pollinated with bees, and hand-pollinated vines in 1990 (Costa, et al., 1993).

This study proves how crucial and delicate this phase is in determining fruit size and how pollination techniques aid fruit size. Therefore kiwifruit growers should place remarkable attention during the blooming period. Below are described diverse techniques which have been developed to boost the pollination in kiwifruit.

Wind pollination

Wind pollination consists of the movement of pollen from male to female vines by wind. This happens naturally in the orchard but recently it has also been enhanced with mechanical fans installed on

tractors. The success of this technique depends on the blooming synchronization, climate conditions and the male/female ratio. However, even under the most favourable condition, wind alone is not sufficient to produce fruit of 100 g or more (Costa, et al., 1993; Goodwin, 2000).

Honey bees pollination

Among the diverse insects that visit kiwifruit flowers, honey bees are the most commonly used. They transferred male pollen to female flowers. A single bee visit can produce more than 200 seeds (Goodwin, 2000). Hives are introduced in the orchard when 10 to 20% of the female flowers are open, and their number is generally around 8-10 hives per hectare. Honeybees can successfully pollinate kiwifruit but their flower visiting is highly dependent on weather conditions. Scarce pollinations have been seen in seasons when they appeared to have low temperature, excessive rain and cloudy weather conditions.

Artificial pollination

Artificial pollination has been demonstrated to be effective in pollinating kiwifruit in several scientific studies (Costa, et al., 1993; Gonzales, et al., 1998; Asteggiano, et al., 2010). A great advantage of this technique is that it reduces the risks of the growers. If it is correctly held, it can guarantee successful results even with adverse weather conditions (Gonzales, et al., 1998). Kiwifruit pollen can be stored for 2-3 years at -20 °C and applied when needed (Goodwin, 2000) in combination with wind and/or honeybees to increase fruit size. However, it should be taken into account that artificial pollination is an expensive practice and it is important that the extra costs of implementing it will be repaid by the fruit size achieved (Goodwin, 2000).

The pollen is applied to female flowers by three basic principles, direct contact, wet, or dry. Direct contact consists in the application by hand flowers by flower. The reliability and effectiveness of this technique in fully pollinate the female flower has been proved by several studies that it is often used as an experimental tool. Nevertheless, it is labour intensive. Usually, pollinating 1 hectare of canopy area takes between 130 to 180 hours. Thus, large plantations encounter difficulties in implementing this approach. The second artificial technique is the wet method. Male pollen is dissolved in a solution designed to maintain its viability and with different devices it is applied. Lastly, there is the dry method. Pollen is distributed with devices that create an air current. For both wet and dry method, there is specific equipment that requires hours of labour. It is important to emphasize that the more precise the application of the pollen to female flowers is the better results are. Hand pollinator devices are often preferred than mechanic distributors.

To sum up, kiwifruit pollination is crucial in determining marketable fruits. The relationship between seed number and fruit weight is commonly known. It is also clear that rely the pollination only on one method might give unsatisfactory fruit size. Adverse weather conditions compromise honeybees' activity and frequent rains during the blooming period increase the risks of having scarce pollination results. It is therefore fundamental to use complementary pollination practices (Asteggiano, et al., 2010).

3.3.4 Soil and water management

Plant nutrition

Soil fertility is essential to sustain production as well as minimizing the environmental impact of kiwifruit orchard. Fertilization programmes should take into account the amount of nutrients required

by the vines along the different phenology phases, the one already available in the soil and the minerals coming from the mineralization of soil organic matter (Xiloyannis, et al., 2011).

Soil and leaf analysis are two complementary tools to evaluate soil fertility, vine status, and design fertilization programs (Table 4). The objective of these analyses is to determine whether there are deficiencies and/or excesses of nutrients and to ensure that growers timely adjust fertilizers inputs along the diverse growth phases. Soil testing is usually held annually in late winter and before adding any type of fertilizers. Physical and chemical information of the soil are then evaluated by the growers in consultation with experts of designing fertilization program for the coming year. A direct assessment of the nutrient intake and specific symptoms (i.e. toxicities) (Sher, 2008) is done by leaf tissue sampling. Growers conduct leaf testing usually twice a year. Eight weeks after leaf emergence (pre-flowering), leafs are analysed to detect any nutrient deficiencies (potassium contents). This allowed the growers to immediately correct fertilization program. The second leaf analysis is usually carried in the mid-season (mid-summer) when nutrients level is stabilized. Here, the opportunity to correct nutrient deficiencies is limited, but vine status data is used to make adjustments for the following season's nutrient programme (Sher, 2008).

Analysis	Phenological phase	Benefits
Soil testing	Mid-winter (before any nutrient applications)	-Determine nutritional status of the soil -Design fertilization programme
Leaf testing	Pre-flowering (eight weeks after leaf emergence)	-Early correcting actions -Modification of the fertilization programme
Leaf testing	Mid-season (when nutrient level are stable)	-Evaluation of the nutrient availability during spring -Adjustments for the following seasons programme
Water testing	Before summer	-Identification of minerals applied by water -Interaction with fertilizers programmes

Table 4: Soil and leaf analysis used to control vine status.

Water is also analysed to measure the chemicals contained. Vine nutrition might be affected by the high content of minerals in the water (Sher, 2008). For instance, total dissolved salts should not exceed the electrical conductivity of 2.5 micro mhos/cm (Sher, 2008).

Fertilization practice differs from orchard to orchard and several are the parameters that should be taken into account when designing nutritional programmes. According to Pentreath (2011), it is fundamental to *"tailor the fertilization program to the single orchard needs by utilising analytical results, technical expertise and smart tool to ensure optimal returns while minimizing the environmental impacts"*. The fertilization of kiwifruit should take into the right dose in each phase. For instance the amount of nitrogen (N) and calcium (Ca) might affect the quality of DM (Boyd, 2005; Boyd & Barnett, 2010).

Irrigation management

Judd et al. (1989) stated that "the economic returns of kiwifruit depend strongly on individual fruit sizes, which are in turn directly affected by water availability". To prevent the vines from suffering water stress, kiwifruit orchards are regularly irrigated. Summer drought and scarce rains justify the economic effort afforded by growers to irrigate kiwifruit vines (Xiloyannis, et al., 2011).

Judd (1989) and Miller (1998) proved that after fruit set, water stress has a direct effect on fruit growth. A reduction of the average size is visible in Figure 11 (Miller, et al., 1998). Vines were water stressed in two moments of fruit development, that are 10 (water stress 1) and 90 (water stress 2) days after the

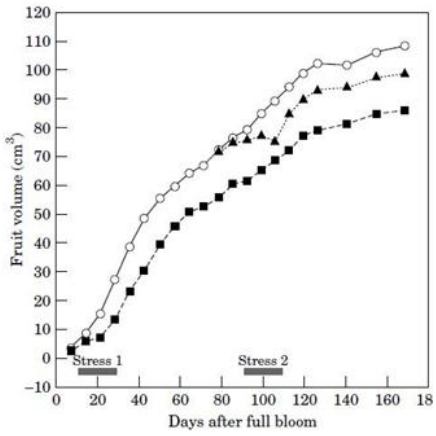

Figure 11: Changes in kiwifruit volume from fruit set to harvest and the effects on growth when a water stress is imposed in early (■) or late summer (▲) compared to control vines (o) (Miller, et al., 1998).

full bloom respectively. Compared to the control, significant fruit size reduction was seen in the water stress 1. However, water stress 2 caused lesser reduction and an increase of DM.

Overwatering kiwifruit vines in the early and late stage of fruit development might also affect quality. A reduction of DM has been proved by more fruit water uptake. This was even more evident when fruit have been treated with growth stimulants (Morton & Woolley, 2011).

Multiple are the factors in determining the correct water amount. Factors such as temperature, humidity, radiation intensity and wind are indicators used by the growers to daily adjust irrigation frequency and volumes.

3.3.5 Bio-stimulants

Obtaining marketable size fruit is an important determinant of orchard profitability (Patterson & Currie, 2010). Bio-stimulators are adopted in farm management to achieve high yield of ideal size (ideal-sized) fruit. Within the category of bio-stimulants, there are products that improve the development of buds and flowers such as: HiCane® or Dormex® -defined as dormancy breaking agents- and those products that directly influence fruit morphogenesis, also called fruit sizing stimulators and/or growth activators.

3.3.6 Dormancy breaking agents

These bio-stimulators are usually adopted in certain climatic areas to overcome the lack of chilling requirement during winter (Costa, et al., 2011). Kiwifruit plantations located in warm cultivating areas are often affected by scarce differentiation of flower buds which results in scarce yield and low rate of marketable fruits. By applying dormancy breaking agents, the bud-break and fertility are expected to increase (will increase) (Patterson & Currie, 2010; Costa, et al., 2011). As a secondary effect, dormancy breaking agents strongly reduce unwanted lateral flowers (flowers malformation), which reduces greatly thinning costs (Hernández & Craig, 2011), stimulate contemporary blooming (Costa, et al., 2011) , and they also contribute to increase the average size of the fruit produced (Mc Pherson, et al., 2001). These dormancy breaking agents are normally applied in mid-winter, 40-45 days before the expected bud-brake, to stimulate the hormone maturation of the flower buds.

Their usage among growers has been increased in the last decade. However, recently hydrogen cyanamid (Dormex®, HiCane®) has been restricted for dormancy interruption within the EU. New Zealand growers have raised serious concerns about how long these products will be available and what are the other alternatives available in the market (Hernández & Craig, 2011). Other two dormancy breaking products Erger® and Armobreak® were tested and compared with HiCane® on Hayward kiwifruit (*Actinida deliciosa* var. *deliciosa* 'Hayward').

3.3.7 Growth activators

Within this category, there are formulas used to increase consistently fruit size. Commercial products are Sitofex®, Caplit®, Maxim®, Spray Dunger Global® and Benefit®. The great advantage of using them, for instance Benefit applied on the Zespri™Gold, is the increase in fruit weight from c. 95 to 125 g (Patterson, et al., 2003). Thus, these bio-stimulators can make differences in terms of crop load and fruit weights. However, recently there has been more attention on the adoption of the bio-stimulators. If they enhance fruit size and by two/three applications growers can increase their productivity, several scientific papers demonstrate that these fruit often hardly reach high level of dry matter (taste) (Patterson & Currie, 2010). Moreover, the storability life can be affected and it must be pointed out that the use of these compounds is restricted in some crop protection programmes (Costa, et al., 2011).

It should be stressed that although these bio-stimulants can enhance the grower productivity, negative effects, such as low dry matter and low storability, can be seen when they are applied on orchard where inappropriate cultural techniques were used. Especially when the grower mistaken in managing orchard with scarce pollination, high crop load, or inappropriate pruning, the effect of these stimulators can even be more negative (short cold storage life or higher storage disease susceptibility) (Costa, et al., 2011). It is therefore fundamental that kiwifruit growers have a deep knowledge regarding the use of these products and the physiological effect they cause on the morphogenesis of kiwifruit.

3.3.8 Pest and diseases management

Pest and diseases management includes all the practices aimed on preserving the health conditions of vines and the quality of fruits. The control of pest and diseases is fundamental to guarantee the production of qualitative fruit. Grower's knowledge concerning crop protection practices is essential to meet the legal requirements of export markets (such as maximum residue limits) as well as environmentally responsible usage of pesticide. Fungi and bacterial diseases can compromise the quality of fruit and therefore the productivity. To support growers' decision-making, Zespri has established a crop protection programmes (CPPs) that list the allowed agrichemical products, their rates of application and time required to limits of their applications before harvest (www.canopy.zespri.com).

Among the few pests and diseases, a bacterium called Pseudomonas Syringae pv. Actinidiae (*Psa*) is considered as the most serious threat for the world production of kiwifruit up to date (Mazzaglia, et al., 2012). This bacterial canker of kiwifruit was firstly identified in Japan in 1984 (Serizawa, et al., 1989), then in Korea (Koh & Lee, 1992) and Italy in 1992 (Scortichini, 1994). In 2010, *Psa* disease was found on A. Deliciosa and A. Chinensis in New Zealand (Everett, et al., 2011). *Psa* symptom is a red exudate visible from infected parts such as canes, leaders and trunk. Usually red exudate appears in the early spring on fruit canes, and later in the season the infected canes tend to die and the fruit collapse (Balestra, et al., 2009; Vanneste, et al., 2010). Phytosanitary practices aim on containing the infections. Agronomical practices such as the removal of the infected parts, the continuous monitoring of the orchard vines, and the application of bactericides products that reduces *Psa* population are all held by growers. Fundamental is the coordination of these practices with research institutions and cooperatives that can provide crucial guidelines and updated information about climatic condition that might favour this pathogen.

To tackle this problem, Zespri is in collaboration with diverse institutions and organizations of the kiwifruit industry and has established an entity to assist growers. Kiwifruit Vine Health (KVH) is a

website which contains information about *Psa*. Bulletins, status updates, seasonal management guide, seminars, and research outcomes are transferred to growers from time-to-time. Seasonal management advice give guidelines of orchard hygiene, spray information, seasonal monitoring and reporting symptoms, sampling and testing, vine removal and disposal, and so on (www.kvh.org.nz).

3.3.9 Farm practices conclusion

The above discussed farm practices/techniques are essential for achieving the growers' profitability. Seasonal factors are still fundamental determinants of vines development. However, according to Woodward and Patterson (2008; 2009) *"top performing growers integrate a range of vine manipulation techniques and consistently achieve very high fruit productivity over several seasons"*. While climate factors are crucial factors that influence the physiological growth of the kiwifruit vines, high performing growers are able to adapt cultural practices properly and often obtain productions which are above the industry averages (Woodward & Patterson, 2009). Even concerning quality of kiwifruit (DM), there is a clear evidence that the grower management factors have significantly higher impact than any differences induced by seasonal effect (Patterson & Currie, 2010). This confirms the hypothesis that farmer's practices and inputs are the main determinants in the production of kiwifruit.

3.4 Chain' actors activities and interests

Chain actors' activities and interests include those chain factors that have an influence on the growers activity and therefore on the productivity. Significant importance is given to technical assistance, information exchange, diffusion of innovations and chain management practices referring to the organizations located next to the growers in the chain. They are cooperatives, Zespri, and suppliers of agricultural products.

3.4.1 Technical support

The assistance provided by cooperative, Zespri and suppliers in addition with the farmer's knowledge, experience and skills is crucial in the day-to-day farming decisions. Henderson and Quandt (1958) stated that *"the best utilization of any particular input combination is a technical not an economic problem"*. An interesting aspect founded by Mook (1981) is that any type of education imparting knowledge about the cultivating process increases the production possibilities. In other words, any combination of inputs managed by the grower who has more production-relevant education can produce more output (Kilpatrick, 2000).

Today, growers need to deal with complex issues such as regulations, environmental implications and changes of the food industries (Greer, et al., 1995). The complexity of these decisions highlights the necessity of growers to consult expertise to rapidly adjust their business (Walker, 2002). To do so, growers, extensionists and scientists have to collaborate and conduct research together through social learning processes, which are often referred to as 'partnerships' (Warner, 2005). For instance, among the EU sugar beet growers, the exchange of technical information within the chain has always been crucial for the efficiency and profitability of beet producers (May & Fisher, 2001). Technical assistance and information transfer are therefore essential to optimize the cultivation practices of kiwifruit growers.

The transmission and integration of knowledge between growers and scientists have been studied in several cases of agro-ecology and organic agriculture (Warner, 2005; Barbercheck, et al., 2011). Particular attention has been placed on growers' participation in programmes of co-learning and knowledge exchange. Initiatives as such, aimed on implementing new cultural practices to conserve

natural resources and enhance grower returns. It is demonstrated that scientists and growers have to learn from each other. Auburn and Baker (1992) experienced that *"knowledge exchange is accelerated through farm-scale joint research"*. Warmer (2005) referred that major participations were seen among growers of perennial crops (e.g. kiwifruit) for the reason that:

a) Growers have invested time in learning about the crop,
b) These crops are multi-decades investment of capital and labour,
c) Perennial crops have a long history of cooperative marketing and collective actions (Warner, 2005).

This has called attention to the importance of the technical support, especially on how frequently cooperatives and Zespri's technicians give technical information to kiwifruit growers. And by considering the previous studies, this will create development and promote progress in the sector.

3.4.2 Technical information within kiwifruit industry

Managing a kiwifruit orchard is a multidisciplinary activity which requires support of external expertise. Everyday growers deal with a wide range of problems that require scientific and/or managerial, and economic knowledge. Climate change, new varieties, and particular diseases are continuously challenging kiwifruit growers. Because of these changes consultation with expert might provide extra support and information which could be used to better perform the farming activities held by the kiwifruit growers. And universities, research institutes, supplier of agricultural products, Zespri and cooperatives are all providing technical support. An example of how New Zealand kiwifruit chain players have been dealing with this issue is given in the next paragraph.

Zespri programmes in New Zealand

In New Zealand, Zespri is committed in helping growers who want to achieve higher yield and optimize their orchards' profitability. And to do so, it has promoted initiatives to stimulate a co-learning process between growers and scientists. Focus Orchard Network, Orchard Productivity Centre, Kiwi-Tech seminars, field days (excursions and meetings), industry publications (Kiwiflier, Kiwifruit Journal), and the Zespri Canopy website (www.canopy.zespri.com) are all initiatives aiming on the diffusion and integrations of the technical information. Two of these programs are reported in the following sub-chapter as an example of dissemination of the technical support in a highly integrated kiwifruit chain such as the New Zealand one.

Focus Orchard Network (FON)

A programme called Focus Orchard Network (FON) groups gathers growers, technical staff, agronomists and scientists and promotes the dissemination of information with an objective of boosting growers' performance. The program is based on the confrontations and demonstrations of diverse management practices and on-orchard decisions and selected growers' orchards are the representative cases. The aim is to transfer knowledge to growers by showing possible options and to evaluate the inputs usage with specialists. Cultural practices are then evaluated under cost analysis, yield achieved, utilization of the resources, and so on. To disseminate such information, this programme uses field days (excursions and meetings), industry publications (Kiwiflier, Kiwifruit Journal and Field day hand outs), and the Zespri Canopy website.

Performance of these targeted orchards are then benchmarked against other growers and against the industry average. This will provide the evidence that there are growers who reach significant productions and which practices they adopt to do so Invalid source specified.. Benchmarking farmers'

performance has been also used in European sustainability programs. The benchmark tool was used to enhance *inter-farm competition* concerning environmental impact and to stimulate awareness among growers for the usage of pesticides. In the pilot group of Dutch growers studied by Snoo (2006) they positively respond to the benchmark tool, showing willingness to compare their own performance with the one of others.

Orchard Productivity Centre

Another programme implemented to boost productivity among growers is the Orchard Productivity Centre (OPC). This initiative embraces Zespri departments and key players of the kiwifruit industry to ensure the transmission and adoption of new practices. This guarantees that growers are continuously updated regarding new techniques to improve quality and productivity. That can be achieved by the identification of industry best practices, introduction of new cultivars, tech transfer capability, and analytical assessment of performance. Here, Zespri is the interface provider between teams, research centres, growers and other industry actors. Seasonal Kiwi-Tech seminar updates growers about practices used in a particular phonological phase. Critical issues covers pollination, optimization of the performance of new varieties, male synchrony, research on diseases tolerant cultivars, season performance, yield balance and dry matter content, productivity increase through improved pollination, and so on.

3.4.3 Cooperative technical services

Technical assistance and documentation compliance are offered by the cooperative's technicians (Pacino, et al., 2011). Cooperatives have experts and technicians that periodically visit growers' orchards. They monitor the status of vines, fruit development, diseases, and water supply. A direct relationship between these technicians and growers is often characterized by trust. Seasonal themed meetings teach, inform, and translate technical information to growers. Training courses instruct growers about farm risks, environmental issues, and new certifications for exporting as well as economic analysis concerning market trend, customer response, and operational costs.

3.4.4 Supplier of agricultural products

On-farm decisions are also influenced by suppliers of agricultural products. Specialized shops that sell agricultural products such as fertilizers, pesticides, herbicides and bio-stimulants frequently offer technical advice to growers. This relationship is based on a face-to-face information transfer. Furthermore, these organizations offer updated information concerning new agricultural products in the market. But also they know which product has been banned in the EU and which one is not authorized by Zespri regulations.

3.5 Information transparency

The information diffusion among supply chain members has been directly associated with the trust level. Akkermans *et al.,* (2004) define the information transparency within the chain as *"the result of reinforcing dynamic interactions between trust levels of chain partners"*. Information transparency shared with the chain depends on how closely chain members work together. *"The more supply chain partners work closely together, the more they will trust each other, and the more data they will dare to share"* (Akkermans, et al., 2004).

Forrester (1961) first identified the importance of the information transparency for better decisions along the chain. The study described how information delaying causes demand amplification upstream in the chain. Besides, the concept of trust is defined as *"the belief that the other party will act in the*

firms best interest in circumstances where that other party could take advantage or act opportunistically to gain at the firms expense" (Mc Cutcheon & Stuart, 2000). Anderson and Weitz (1989) then explained how trust is generated. They refer to the past experience and how partners that know each other tend to continue their social exchange over time. De Jong and Nooteboom (2000) associate this phenomenon as human habituation. A repeated interaction between parties led to habit formation and psychological relief among chain players.

After having elucidated a few definitions of trust and information transparency within supply chains, we would like to apply those concepts in the kiwifruit chain. Growers, cooperatives and Zespri are closely interconnected in their operations. Fundamental is their information sharing and trust to be efficient and competitive. Parkhe (1993) referred as scarce opportunistic behaviour within co-operative alliances. So, licensee contracts and association agreements between growers, cooperatives and Zespri might be enough to support a collaborative system. However, in the empirical phase of this study, questions concerning trust and information transparency will be utilized to make clear this issue.

Technology has been used in several agricultural cases to facilitate the information exchange. Decision support systems (DSSs) have been used in agricultural sectors to facilitate the growers' decision making. These tools address a variety of issues such as farm sustainability, improving crop production and use of fertilizers, pest and diseases management, etc. A similar tool is the Zespri Canopy website built to disseminate technical information and to make more transparent and clear the information. All associated growers can access with a password and apprehend knowledge about experiments, farm practices and industry news. This communication tool is efficient and cost-effective, and it also enhances transparency. Thus, questions concerning the use of the Zespri Canopy website will also be included in the questionnaire.

3.6 Innovations

The recognition and implementation of new technologies in the management practices are crucial for improving farm performance (Bella & Martin, 2009). We can consider any technologies and/or new practices as an innovation for the reason that the *"idea or object is perceived new by the farmers"* (Rogers, 1995). The type of innovation that takes place in a farming system is new, including marketing, management, labour use, natural resource management practices, product changes, production practice changes, cropping equipment, and irrigation practices. The innovation process is the *"results of a process of networking and interactive learning among a heterogeneous set of actors such as farmers, input industries, processors, traders, researchers, extensionists, government official, and civil society organizations"* (Klerkx, et al., 2010).

3.6.1 Factors affecting farmers' adoption of agricultural innovations

There are several studies that attempt to tackle factors influencing the rate of innovation adoption in agriculture. Among scientists, there is a common agreement that the adoption of agricultural technologies depends on *"a range of personal, social, cultural and economic factors, as well as on the characteristics of the innovation itself"* (Pannell, et al., 2006; Howley, et al., 2012).

Education and training positively enhance growers' ability to include new management practice in their business (Kilpatrick, 2000). Kilpatrick (2000) investigated how education and training actions affect agricultural and land-management changes among Australian farmers. These farm business changes are also often positively associated with the profitability of the farm. Emphasis is placed on the relationship between education of growers (below secondary, secondary or post-secondary school)

and their participation in education and training events (courses, seminars, conferences and field days) with the rate of adoption of agricultural changes. Kilpatrick (2000) concluded that *"education and training is able to influence change in three broadly defined ways: first, by delivering new knowledge and skills; second, by providing interaction with 'experts' (facilitators, trainers or teachers); and third, by providing opportunities for interaction with peers (fellow training participants)"*. As a result, all the activities aiming on educating and training growers are opportunities to facilitate the implementation of novelties.

Farm size can also be crucial in influencing the adoption of innovation. The positive tendency of a large farm in absorbing technology has been addressed to have a higher profitability, a more risk-bearing capacity, and the economy of scale (Bella & Martin, 2009). Small farms often reflect restricted financial capacities which make more difficult the adoption of changes. In particular, Fenton et al. (2000) referred to the fact that financial characteristics have effects on farmers' decisions to implement novelties.

The complexity, adaptability, risks, and cost of an innovation are also influent features that should be taken when referring to the adoption rate of novelties (Howley, et al., 2012). El-Osta and Morehart (2002) affirmed that *"farm size and specialization in dairy production increased the likelihood of adopting a capital-intensive"*, while the education and the size of the operation promote the adoption of management-intensive technology. Lastly, the interactions between growers and peers, extensionists, researchers, etc., also positively impact on agricultural adoption of innovation (Howley, et al., 2012). Like Prokopy *et.al.*, (2008) summarized in previous research, the implementation of new agricultural practices is the result of heterogeneous factors such as "education levels, capital, income, farm size, access to information, positive environmental attitudes, environmental awareness and utilization of social networks..".

Innovation in the kiwifruit farming system

The sorts of innovations that usually take place in the agriculture are discussed above. However, in this study, the attention is placed on kiwifruit growers associated with cooperatives and Zespri. Innovation about activities such as marketing, distribution channels and commercialization of kiwifruit are not in the objects of this investigation. When considering novelties, we refer to new practices, techniques and management novelties in the kiwifruit farming system. A list of them is provided below.

- New members to farm's management.
- New approaches to labour use.
- New soil-related natural resource management.
- New pest and disease management practices.
- New varieties.
- New products (fertilizers, pesticides, bio-stimulants).

The New Zealand case of innovation diffusion

In New Zealand, Zespri in collaboration with the HortResearch funded a project called Innovative Growing Systems. In the programme, HortResearch experts work alongside with three innovative orchardists and their management teams over a three-year period to investigate the opportunities of increasing fruit yields and therefore grower returns. The inputs and outputs of these plantations are then quantified in all its aspects. And subsequently, information about the novelties adopted is

divulgated to other growers trough tech transfer programme based on discussion groups, field days, workshops and publications (Max, et al., 2007).

3.7 Chain management practices

Aside from the influence that chain players might have on technical services, information, and innovations, the way they operate in the sector can also impact on growers' performance. The coordination of the kiwifruit transportation, refrigeration, quality control, logistics activities do interfere the quality delivered to the final consumers. The type of contracting arrangements between growers and buyers do influence the trust among each other and influence the willingness to cooperate.

3.7.1 Logistics

As we discussed, kiwifruit is transported in a controlled atmosphere (cold chain) and the quality must be preserved along all the passages. Post-harvest operations do influence quality. And the logistics from point of origin to point of consumption might affect it. Controls of quality, pesticide residues, fruit maturity and the postharvest management in general affect fruit quality, the shelf life and export price (Cooper, et al., 2007).

Johnston *et al.,* (2001) asserted that fruit softening is one of the unresolved problems during the storage and transportation which decreases the shelf-life of fruits. For instance, the quality maintenance of mango during the supply chain depends on many aspects at farm and post-harvest operation level. Harvesting practices, packing operation, postharvest treatments, temperature management, transportation, and storage activities prevent the fruit from being damaged (Dharini, et al., 2011).

In the kiwifruit chain, it is also crucial that harvested kiwifruit are immediately cooled down and preserved along all the aforementioned passages. During harvest, cooperatives' staffs coordinate the logistics trucks that load kiwifruit from each farm and then unload batches of fruit which are instantly transferred into cold storage rooms to avoid weight loss and maintain the quality. Following that, there is the handling phase where kiwifruit are graded, packed, and labelled until each quality category satisfies specific market needs and the kiwifruit are ready to be shipped. The coordination of the post-harvest logistics activities might reduce the quality of the final product and result in less return for the growers. Therefore, maximum attention should be placed on post-harvest phases.

3.7.2 Contract farming

Contract farming is particularly common in industrial crops such as sugar cane, tobacco and tea; nonetheless, it can still be found in other crops or farming systems where products are sold to high-income consumers who are willing to pay a premium for quality and food safety (Miyata, et al., 2007). Through contract farming, growers get market access, acquire marketing information, and technology to improve farming performance and inputs (Arumugam, et al., 2010). And in return, large-scale buyers, cooperatives, traders, exporters and/or food processors, ensure a steady supply of raw materials meeting certain quality standards which are in line with supermarkets requirements and with the today increasing demand for high-qualitative food products (Miyata, et al., 2007).

In developing countries, contract farming between small growers and exporters facilitates the implementation of global standards for agricultural producers (Otieno & Knorringa, 2012). However, some criticisms pointed out that *"large agribusiness firms use contracts to take advantage of cheap labour and transfer production risk to farmers"* (Miyata, et al., 2007). In the study of Hu and Hendrikse (2009) explained how *"under contract farming, many decision rights are shifted from*

growers to firms". However, Miyata *et al.,* (2007) and Pandit, *et al.,* (2009) showed that contract farming rises the income of growers especially when it involves small scale growers that hardly can have access to extension agents that provide technical assistance and guidance of the quality standards requirements. Pandit, *et al.,* (2009) also showed that in West Bengal, growers who produce potatoes under contract farming were more experienced and had more years of schooling than the non-contract growers.

Contract farming is commonly used within the kiwifruit industry. There are growers that do not belong to any fruit club and tend to have an independent mind-set *"selling their products to agents offering the best price"* (Hewett, 2003). These growers usually guarantee their productions with yearly agreements (short-term relationships) with their buyers. Often these contracts are signed in the beginning of the season, but there are cases where growers prefer to keep open the opportunity to get higher offers until few weeks before the harvesting. A more integrated collaboration takes place when growers are members of cooperatives and long-term relationships take place. As members, they have access to services and information and in return they deliver their products. This sort of relationships is maintained by more stable relationships which are also guaranteed through contracts.

To guarantee the year-round supply of Zespri Gold and Zespri Green kiwifruit, Zespri partnered with Italian cooperatives and growers. Through contracts Zespri supplied the crafted wood of new varieties e.g. Gold (also protected through propriety rights) *"in exchange for a license after growers and suppliers agreed that Zespri would market the fruit for a margin"* (Alvarez & Shelman, 2010). The interface between Zespri, cooperatives and growers is regulated with a series of contracts. Between growers and Zespri there are contracts that give the right of commercialization to Zespri and allowed the growers to cultivate new varieties. And between Zespri and cooperatives there are supply agreements. Cooperatives collect, pack, and store kiwifruit for Zespri, and in return they get a compensation for the services offered, usually calculated in € per kg of kiwifruit processed.

4 Materials and methods

The methodology partly discussed in Chapter 2 will be extended in more detail in this chapter. Here we summarize the findings from the literature study with the objective to isolate the relevant one and answer to the research question.

4.1 Concepts classification

From the concepts discussed in the literature review and the already grouped factors of Figure 6 (farm management and the chain activities and interests), we identify a set of elements that will facilitate the questionnaire designing process and the formulation of the supposed correlations between group of factors and variables.

In the left boxes of Figure 12 there are the factors found in the literature which describe influential aspects of the: farm characteristics, farm management, farm practices, chain factors, personal characteristics of the grower and the farm performance. The questionnaire will be designed and based on this categorization and on the equivalent factors here reported. In the right boxes of Figure 12 there are the research fields which will be the reclaimed in the main areas of the questionnaire.

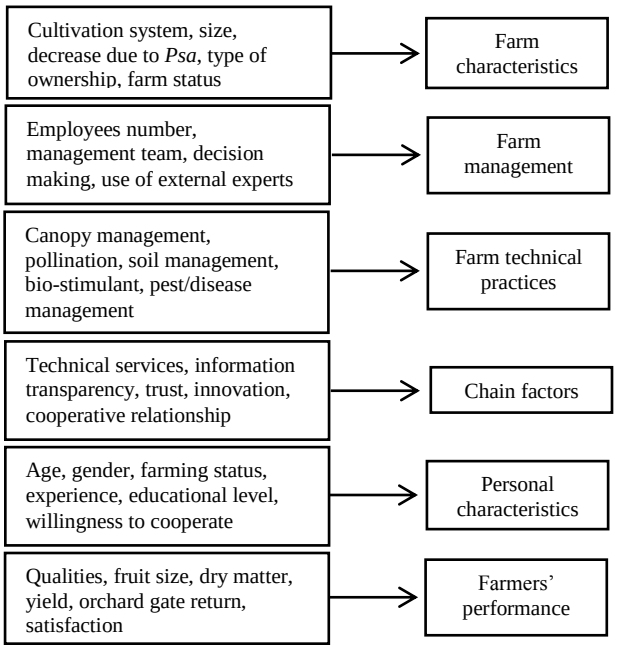

Figure 12: Classification in six main categories of the concepts identified from the literature review.

4.2 Conceptual model

The conceptual model of Figure 13 illustrates the assumed relationships between groups of variables. We distinguish three primary factors which we assume have a direct impact on the farmers' productivity, and two secondary factors which we assume that do not have a direct effect on productivity but have an influence on the primary one.

We presume that within the primary factors, characteristics of the farm can alter growers' productivity as well as farm management factors. For instance, farm size might influence the way farms are managed. Farm management reflects more the education of the growers, the composition of the management team, the workforce, as well as the manner agricultural practices are executed and how information from outside are absorbed. So, we assumed that farm management might influence growers' productivity as well as the technical practices. Moreover, we expect that technical practices directly influence growers' productivity for the reason that they aim at optimizing quality/quantity produced and the more often these practices are conducted the higher the productivity would be.

Within the secondary factors, chain factors and personal characteristics are expected to be less influential on growers' productivity; however, to verify this hypothesis we associated them with growers' productivity. Moreover, as described in the literature review, chain factors and all their activities and interests do interfere with growers operations. They are expected to have an effect on the farm management for the reason that the technical support, innovations, information and other services

or inputs might alter the farm management and also change technical practices implemented. We think that personal characteristics such as age, gender, farming status, experience, educational level and willingness to cooperate would show a conjuncture with the way the farm is managed and with the technical practices adopted by the farmers.

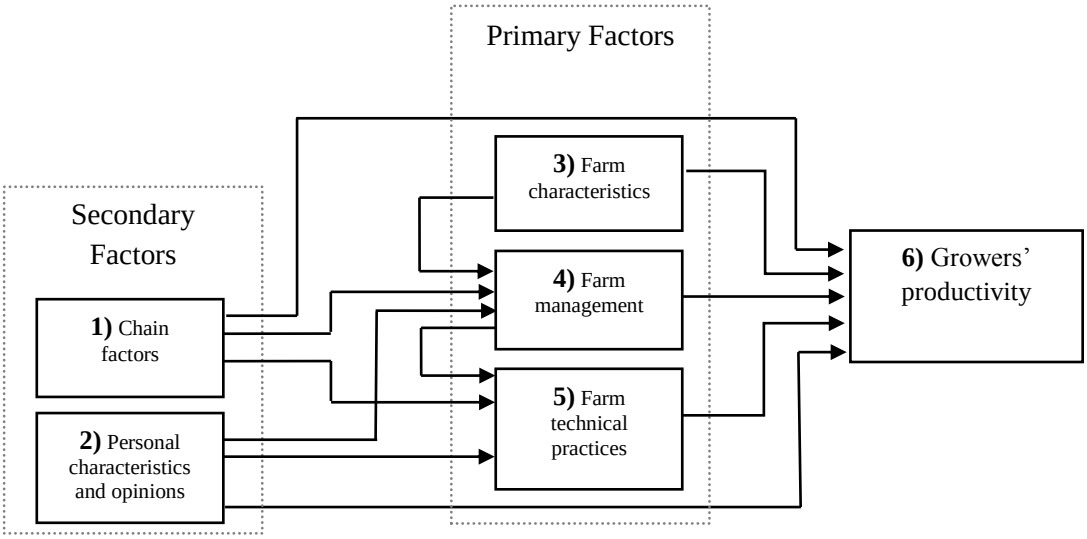

Figure 13: Conceptual model showing possible relationships among primary and secondary factors in affecting growers' productivity.

The general message behind this model is to graphically illustrate the possible associations between variables by taking into account the objective of this study. By referring to our research question, 11 probable relationships have been identified (illustrated by the arrows). These associations have been considered by us as the most interesting one after the description of the concepts and theories yielded in the literature review.

4.3 Relationships between factors

In this Chapter we explain the reasons that motivate the identifications of these 11 relationships. Based on the model (Figure 13) and on the aforementioned group the factors of Figure 12, we frame some questions to clarify the hypothesized relationships. In the following text we will explain the assumed relations by following the group of factors order, and to facilitate their distinctions we numbered them from 1 to 11.

Farm characteristics associations

In what measure farm characteristics such as area of cultivation, cultivation system, farm size, *Psa* outbreak and type of ownership influence grower's productivity and farm management factors?"

Relationship 3: *(3→6)*

a) We presume that recent new varieties such as Zespri Gold tend to produce more.
b) We assume that the bigger the farm size, the higher is the productivity.
c) We assume that the lower is the *Psa* outbreak, the higher is the productivity.

How is the influence of the farm characteristics on the farm management?

Relationship 10: *(3→4)*

a) We assume that the larger the farm is the more effective is the management team.

d) We believe that the larger is the farm and the more innovations are implemented with a consecutive reflection in the whole management.
e) We assume that the bigger is the farm and the more skilled are the employees (permanent employees) who are positively reflected in a better control of *Psa* and more production.

Farm management associations

In what measure the farm management influences the productivity and the farm management practices?

Relationship 4: *(4→6)*

a) We assume that the more specialized employees the farm possess, the more productive is the farm.

Relationship 11: *(4→5)*

a) We suppose that the more skilled and educated is the management team, the more rapidly and effectively the farm practices are implemented.

Farm technical practices associations

In what measure the farm technical practices and their implementation influence growers' productivity?

Relationship 5: *(5→6)*

a) We assume that there is a strong correlation between farm technical practices and the achievement of the growers' productivity. Farm technical practices are all techniques implemented to produce kiwifruit, thus, they are highly associated with the growers' productivity. As a result, we suppose that the more these practices are implemented, the higher is the productivity.

Chain factors associations

In which way chain factors do influence growers' productivity, farm management and farm technical practices?

Relationship 1: *(1→6)*

a) We think that the more services and support is given to the farmers, the higher is the productivity.

Relationship 6: *(1→4)*

a) We assume that the more qualitative and regular is the technical support, the more updated the management team can become.
b) The more transparent are the information shared, the more effective would be the implementation of the farm management strategies and of innovations.
c) The more trust there is in the chain, the more effective would be the collaboration of the management team with other organizations.

Relationship 7: *(1→5)*

a) The better is the technical support offered by chain players, the more effective would be the implementation of farm practices (canopy management, pollination, soil management, and bio-stimulants, pest and diseases management).

Personal characteristics and opinions

- Do growers' personal characteristics and opinions have an effect on growers' productivity, on farm management and on farm technical practices?

Relationship 2: *(2→6)*

a) We assume that the more educated, experienced, and young the growers are, the higher the growers' productivity is.
b) We believe that the more positive, satisfied, and willing to cooperate the growers are, the higher their productivity is.

Relationship 8: *(2→4)*

a) We suppose that growers with high satisfaction, positive future prospective and willingness to cooperate are the one who tend to be more dynamic and ready to adapt to chances is the management of the farm.
b) The younger are the grower, the more innovations and new practices are implemented in their farms.

Relationship 9: *(2→5)*

a) The more committed, educated and involved in the kiwifruit production (as primary activity) is the farmer, the more precise and effective is the implementation of the technical practices.

Although in the above description the relationships do not follow the numerical order, the relationships from one to five intend to determine which variables most influence growers' productivity, and the following relations from six to 11 aim at describing possible other interferences between the factors taken in to account. From the filled questionnaire data, the assumed relationships will be tested and discussed with the support of SPSS.

4.4 Questionnaire design

The methodology applied to design the questionnaire has been introduced in the research strategy definition of Chapter 2.2.1. Based on the literature review findings, theories were selected and converted into variables which were then translated into questions. Referring to Figure 12, the variables were grouped into factors. The questionnaire covers the six main areas of investigations (farm characteristics, farm management, farm technical practices, growers' productivity, chain factors and personal characteristics and opinions).

Examples of other surveys were used to design our questionnaire, and in some cases we selected agricultural topics related with our study. To begin with, one of the questionnaire samples is conducted in 2007 to assess the New Zealand kiwifruit sector on a number of topical dimensions (Fairweather, et al., 2007). In particular, the survey was held by the AGROS organization (Agriculture Research Group on Sustainability) to understand the conditions and the differences of New Zealand growers cultivating kiwifruit in the conventional and organic way. Another survey consulted is the one implemented in the Nepalese agricultural sector to investigate economic condition of the growers (Goletti, et al., 2001). Although we did not pre-test the questionnaire in the real environment, multiple revisions have been conducted to improve it. We discussed its validity and effectiveness with our supervisor Jacques Trienekens, with Stefano Pascucci, and also it was validated with two experts of the Italian Zespri divisions (Mariarosaria Mazzeo and Callum Kay).

The description of the variables selected from the literature study, their conversion into questions and the reasons why we selected those will be explained in more details in Appendix I. The questionnaire contains 31 questions of which some contain sub-questions. Starting with questions of the general characteristics of the farm (Questions 1, 2, 3, 4, 5, 31), the questionnaire continues with three questions about grower's productivity (Questions 6, 7, 8). Then, it covers aspects of the farm management (Questions 12, 13, 14, 15, 17, 28), farm technical practices (Question 16), chain factors (Questions 18,

19, 20, 21, 23, 25), and lastly personal characteristics and opinions (Questions 9, 10, 11, 22, 24, 26, 27, 29, 30). The layout of the questions is based on the five-level Likert scale, nominal questions as well as yes/no questions combined with some open questions.

4.5 Description of the population

Italian kiwifruit plantations are concentrated in a few regions of the north, centre and south of Italy. With years, cultivated hectares of kiwifruit grew particularly in specific areas that became significantly specialized in producing kiwifruit. Among those, Lazio Region is *"the most important area for kiwifruit production in Italy"* (Famiania, et al., 2012). It produces about 37% of the national volume which corresponds to about 10% of the world production (Testolin & Ferguson, 2009; Famiania, et al., 2012). Kiwifruit plantations are principally located in the southern part of Lazio in Latina province, where climate condition and soil characteristics are suitable for kiwifruit. In this area, kiwifruit growers' productions are certified through the Protected Geographic Denomination (PGI) called "Kiwi Latina" (Cacioppo, 2004; Famiania, et al., 2012) and within this PGI consortium, there are several municipalities including Latina, Cisterna, Aprilia, and other smaller adjacent areas.

Hayward and Zespri Gold kiwifruit are the two most common varieties cultivated in this area. One is the normal consumed Hayward kiwifruit that takes the name from horticulturalist Hayward Wright, and has been cultivated in Italy since its introduction in 1969. Meanwhile, the other one is a yellow flesh kiwifruit called Zespri Gold. It was introduced around 2000 and has always been protected by the Zespri propriety rights since then. The kiwifruit production specialization of the Lazio area in accordance with significant volumes produced is the main reason why Zespri leased the Zespri Gold variety mostly in this area.

Our survey was carried out during September/October 2012 in central Italy with particular attention the area of Latina. The population was chosen and reached with the help of Zespri Latina office. Through their network we had access to 85 Zespri Gold growers' emails (centre and north of Italy) and also the contacts of several Hayward growers located mostly in the Lazio region. The data collection was carried out by two different means. First, we sent an internet-based questionnaire to the growers who we had email address. Second, we went to several farms principally located in Latina province and in the surrounding areas for collecting surveys.

By directly visiting their farm, we discussed about their general satisfaction and opinions about the sector while answering to the questionnaire. Through the personal contacts with the sample it became clear that growers' characteristics vary from case to case. Every grower has unique features starting from farm characteristics, passing through personal experiences and knowledge. As a result, the cases investigated are very dissimilar and unique.

4.5.1 Survey responses

Of 85 growers' emails accessed, we obtained 34 filled questionnaires. To arrive at such response number, we sent the questionnaire four times. Besides, we collected additional 40 answers by visiting growers' farms. In total, we reached 74 respondents with 56 growers of cultivate Hayward kiwifruit, 35 growers of cultivate Zespri Gold and some of them have both cultivar and/or other varieties.

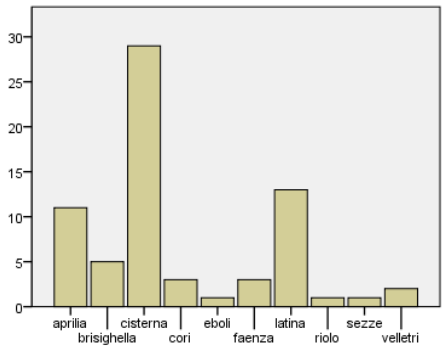

Figure 14: Locations of the sample.

As discussed before, our investigation was carried out mostly in the Lazio Region and the data collected refers to a large extend to the centre of Italy (Figure 14). 29 respondents are from Cisterna, 13 from Latina, 11 from Aprilia and other 12 from neighbouring municipalities (Cori, Riolo, Sezze and Velletri). These cases are all located within the Protected Geographic Denomination called "Kiwi Latina". In addition, we got five respondents from Brisighella and three from Faenza that answered by internet. They are located in a north region called Emilia Romagna.

		Hectares of Zespri Gold in 2011	Hectares of Hayward in 2011	Hectares of Hayward organic in 2011	Hectares of other varieties in 2011
N	Valid	35	56	6	12
	Missing	39	18	68	62
Mean		3.914	8.323	5.000	4.250
Mode		2.0	2.0	3.0	1.0

Table 5: Kiwifruit cultivated hectares of our sample.

As it is illustrated in table 5, the two most common agricultural systems of our sample are Zespri Gold (35 orchards) and Hayward (56 orchards), while only 6 growers cultivate Hayward Organic and 12 have other varieties. The average size of both Zespri Gold and Hayward kiwifruit orchard is about two hectares. It is clear that although the mean shows higher values, due to the presence of few large plantations, the most common answer regarding the size of the kiwifruit orchard is around two hectares. This is also showed by owner-farmed agricultural area where the cultivated size is the total land of the growers (Figure 15). It is evident that the most frequent farm size is below two hectares.

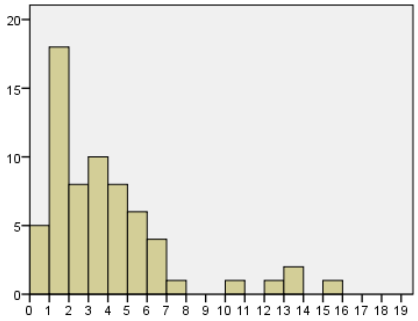

Figure 15: Sample's farm size in hectares.

According to Figure 15, we can distinguish several farms below five/six hectares and less frequent larger farms. 56.3% of the cases are below and/or 10 hectares, 35.3% have a farm between 10 and 50 hectares, and only 8.4% are above 50 hectares. In Figure 15, we neglected farms over 20 ha in order to illustrate and concentrate the attention to the majority of our sample which are below 20 ha.

What we can learn from the aforementioned considerations is that within our sample, Hayward and Zespri Gold kiwifruit varieties are the most cultivated in Latina region. Our population is representative of the Italian kiwifruit sector for the reason that the population is from Lazio region which -as stated above- is the central producing area for the national kiwifruit industry.

Furthermore, we saw that in general kiwifruit plantations are quite small. This sample is characterized by the presence of small farms which have kiwifruit plantations around two hectares. Only six farms are larger than 50 hectares. This intrinsic characteristic of how kiwifruit sector is constituted by several small farms demonstrates the importance of trading companies and/or other intermediaries that want to supply large volumes to retailers need to maintain the relationships with a considerable number of small farms. As a result, the collaboration with the chain seems to be fundamental to reach volumes of highly qualitative standardized fruits.

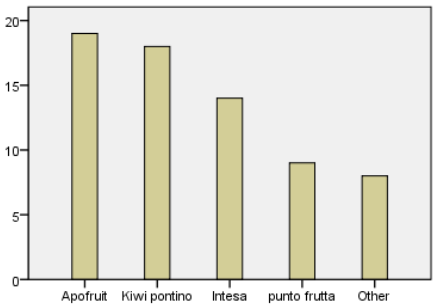

Figure 16: Kiwifruit cooperatives.

Our sample is associated mostly with four cooperatives that work closely with Zespri. The bar chart of Figure 16 describes the distribution of the sample among those. 19 cases are associated to Apofruit, 18 to Kiwi Pontino, 14 to Intesa, 9 to Punto Frutta and 8 growers are associated to smaller cooperatives. Although there are quite a few traders and small other cooperatives and/or organizations that commercialize kiwifruit in that area, these four ones are the largest and the most representative.

The average length of membership association with each of these cooperative is about 12.03 years. The extreme cases are from one to 40 years of association, thus it is difficult to evaluate whether relationship between kiwifruit growers and their cooperatives are short, medium or long term relationships. From the frequencies analysis calculated by SPSS, it emerged that 39.7% of our sample have been associated for less than six years, followed by 31.7% of them showing medium-term relationships (between 6 and 16 years), and lastly, the very loyal growers (28.6%) are found associated from 16 to 40 years.

These findings can be associated with the rather high age of growers. The average age of our sample is 50.77 years old. The range varies from growers of 20 years old to the oldest which is 77. The analysis showed the significant scarce presence of young growers. It appeared that 81.8% of the population is above 40 years old according to the calculation.

It is clear that the lengths of relationships between kiwifruit and cooperatives are different. Shorter associations might be reflected in growers who have an independent mind-set and aim at selling kiwifruit to agents offering the best price. While long-term relationships take place between the very old growers and the first cooperatives established in this area, clear evidence demonstrates the rather high presence of old growers. The data calculated from our sample supports that a relative low involvement of the young generation in the sector might be a threat for the future of the sector.

5 Results analysis

With the support of SPSS, we analyse our sample by two different approaches. Initially, we process the data with the objective to determine the trend and distribution of each variable investigated (questionnaire's question). Based on the descriptive statistic results, we will describe our sample's tendencies and characteristics. In the second part of this chapter, we will illustrate the correlations among different variables with the objective to understand the main causes affecting growers' productivity and how related these factors are.

5.1 Descriptive statistics

In this chapter, the attention is placed on descriptive statistic parameters such as frequencies, mean, median, mode, standard deviation, variance, range that give an overall descriptive picture of the responses. The discussions and interpretations of the results are based on charts and tables calculated with SPSS. In some cases they are placed next to the text and in other cases we prefer to place the less relevant in Appendix III.

Farm characteristics

Infection rate from Psa

The *Psa* average infection rate from 2009 to 2011 is shown in Figure 17. The most frequent answer is between 60-100% because the sample is constituted by several Zespri Gold growers which have been seriously affected by *Psa*. In general, we can distinguish two groups. One is represented by the ex-Zespri Gold that had significant reduction in productivity, and the other group is in the left side of the graph represents Hayward growers. Hayward growers experienced less infection due to the fact that the Hayward variety is more tolerant to *Psa*.

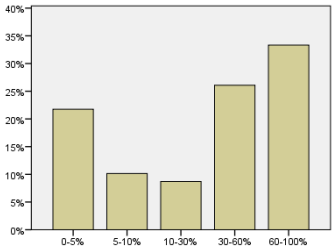

Figure 17: distribution of the infection rate of the investigated cases.

Conversion to other variety

We asked whether at this moment growers are converting their orchards to new varieties and/or are growing again Hayward from the existing rootstock. From the 70 valid answers, there is a similar trend of the previous question. 52% of them are converting their orchard (ex-Zespri Gold farmers), and the other half (47%) are the Hayward growers which did not have significant reduction in productivity. And as a result, only ex-Zespri Gold growers are converting their orchard with other variety.

Type of ownership

To better understand farm characteristics, we asked whether the farm is family owned, collectively owned or is under other forms of ownerships. 78.4% of the farms are family owned, 4.1% are collectively owned, and 6.6% are under other type of ownerships.

Concluding remarks on farm characteristics factors

What we saw from the farm characteristics -that have been also partly discussed in the description of the population- is that there are two main clusters within our samples. One includes Zespri Gold growers that had a serious infection from *Psa* and are converting to new varieties. The other group comprises Hayward growers which did not experience significant decrease in the production and therefore are not converting their orchards. In both groups, the most common type of ownership is family-owned farms. This demonstrates the importance of family business structure of the Italian kiwifruit production sector.

Farm performance

Farm yield

Respondents scored the average yield obtained in 2011 from Zespri Gold and Hayward orchards. Only five growers produced organic kiwifruit and/or other varieties thus the attention is placed on 28 Zespri Gold growers and the 54 growers that produced Hayward. Figures 18 and 19 illustrate Zespri Gold and Hayward yields of the last year season (2011). There are clear huge productivity differences in the yields of both varieties. Within the population interviewed there are growers that produce less than 200 ql/ha and other who exceed the 500 ql/ha.

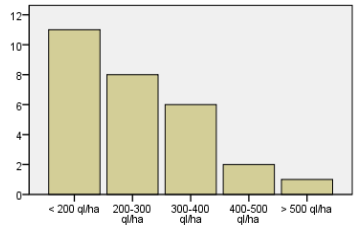

Figure 18: Zespri Gold yield

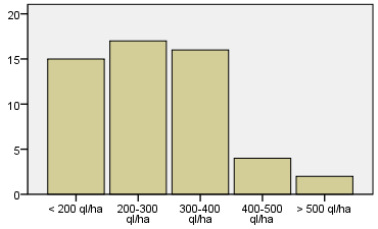

Figure 19: Hayward yield categories.

Figure 18 shows Zespri Gold growers' yields. 28 growers produced Zespri Gold kiwifruit with an average yield of 300 ql/ha. The frequency of cases decreases gradually from the low yields to the high one. Concerning Hayward yield illustrated in Figure 19, 54 growers produced Hayward kiwifruit in 2011. The average yield of the Hayward samples is about 330 ql/ha. A general remarks that appeared from the distribution of cases, is that in both varieties the mostly represented yields value are within the first three categories (<200, 200-300, and 300-400 ql/ha), and only a few growers reached yields of 400-500 ql/ha and rare examples exceed 500 ql/ha.

Orchard Gate Return

Orchard gate return (OGR) is the amount of money that the grower gets (gross income). As we can see in the Figures 20 and 21, OGRs differ significantly between Zespri Gold and Hayward cultivation systems. The mean of Zespri Gold producers' OGR is clearly higher than the Hayward's, which is between 25.000 and 30.000 €/ha (mean value of 4.43) and between 10.000 and 15.000 €/ha (mean value of 2.38) respectively. Furthermore, while best Hayward growers showed a maximum OGR of 20.000-25.000 €/ha, Zespri Gold growers far exceed the OGR of 25.000 with two growers that achieve more than 40.000 €/ha.

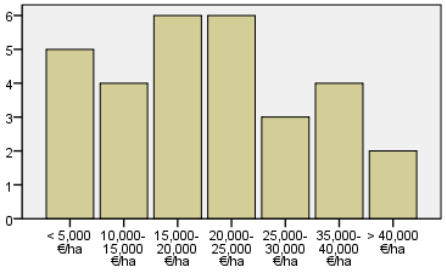

Figure 20: OGR of Zespri Gold growers.

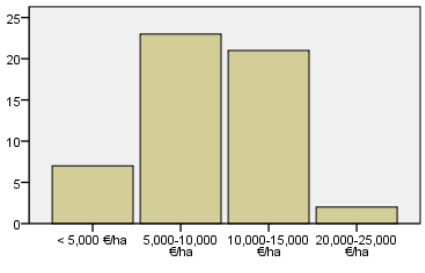

Figure 21: OGR of Hayward growers.

Additional findings can be observed in the ORG distribution. Zespri Gold OGR values are more dispersive (from less than 5.000 to over 40.000 €/ha), whereas Hayward OGR values are more concentrated between 5.000 and 15.000 €/ha. These differences in OGR's values depend on price differences at which kiwifruit are sold.

Concluding remarks on yield and OGR results

From the above findings, it is evident that there are productivity gaps within the examined sample. They confirm the hypothesis stated in the beginning of this study that there are top, average and low performing growers in both Zespri Gold and Hayward kiwifruit agricultural systems. We can observe that the more we move to high yields the fewer cases there are. Basically, top performing grower cases are limited. This tendency is evident in both varieties. Concerning the differences in terms of OGR, it is clear that price makes the difference. Zespri Gold kiwifruit is often paid twice or more of the price of the Hayward one.

Farm management

Seasonal and permanent employees

To understand different aspects of the workforce management, we asked kiwifruit growers the numbers of seasonal and permanent workers. In both questions, they showed certain reluctance in answering and many of them did not clearly express a number. Furthermore, a significant majority consider themselves as the only employees. In some cases, they said that family members also contribute by working a few hours per week but are not considered formal employees. This supports the tendency to rely on familiar workforce along the whole year and use external employees only when more labour is required.

Farm labor management

To deepening the farm labour management and to understand which type of management structure the sample possesses, we formulated extra questions. The respond rate concerning these four questions was rather low (about 50 growers on the 74), and from the face to face interviews respondents demonstrated a certain reluctance in answering.

On the question "I rely on permanent (specialized) employees", 53.1% completely disagree and/or disagree, 18.4% are neutral, and 29.6% agree or completely agree. In contrast, a large percentage of the respondents agreed on the statement "The employees of my farm know the practices and procedures to manage kiwifruit vines". When we asked to rate whether they agree or not with the statement "We have a good team that jointly resolves operational problems", most of the respondents (67.3%) are neutral or disagree. And again, on the statement "I always take farm decisions in consultation with my employees", growers mostly score disagree or completely disagree. The bar charts illustrating the tendencies of these four aspects about farm labour management are in Appendix III (Question 14).

Use of the Zespri Canopy website

Among the 74 growers interviewed, only 50 answered to this question. 28% replied that they have never visited this website, 4% only once a year, and 24% every six months. If we look at the cumulative percentage, 56% of them visit the Zespri website every six months or less. This demonstrates rather low propensity of the kiwifruit growers to use this information tool.

Use of external advisors and technicians

To understand whether kiwifruit growers use external technicians, advisors, and expertise to get information concerning a range of agricultural issues, we ask them to rate how often they request support from experts for managing the canopy, improving the pollination, managing the fertilizations, using bio stimulants, dealing with *Psa* and improving their productivity in general. Though this question we aim at clarifying whether they rely on external advisors, which aspects are most needed, and with what frequencies.

Overall we got 60 respondents out of the 74 interviewees. From the results, kiwifruit growers demonstrated a certain reluctance and independency in managing the canopy. 57.4% of them expressed that they never ask assistance regarding the canopy management. This shows the already acquired experiences in managing the canopy. Concerning the pollination, they showed more propensities in using consultants. About the fertilization management, 46.6% of them expressed that they did ask for recommendations about fertilization practices at least once a month or even every week. In the usage of bio stimulants, 72.6% said that they never ask technicians about how to apply bio-stimulants. When we asked whether they consult technicians concerning *Psa* control, most of them expressed their propensity to get information for *Psa* problem. 70.5% of the growers interviewed said that they contact technicians and ask information about *Psa* at least once a month and/or once a week. This demonstrates that nowadays kiwifruit growers are very worry about this disease significant attention is paid reducing the infections and containing the disease. Lastly, in the question "Do you consult external experts to learn how to improve your productivity", 34.4% of them said that they never asked for such advice. This demonstrates that a large majority of them does not know what are the productivity limits of kiwifruit are and therefore do not ask for improving their productivity.

Full/part-time commitment

78.8% of the respondents are full-time farmer while the rest 21.2% are cultivating kiwifruit as a part-time work with incomes from off-farm work. This data demonstrates that the significant incomes generated from kiwifruit in the past 20 years created several job opportunities in the kiwifruit production industry and turned a number of growers into full-time workers of kiwifruit production.

Concluding remarks on farm management

After having described the results concerning farm management factors, it has emerged that most growers tend to rely on family members instead of accessing specialized employees. They showed reluctance in involving external employees in the decision making of the farm and the majority of them do not have a management team. On the contrary, among the few growers that have permanent (specialized) employees they are considered skilled and trained in managing kiwifruit vines. In general, what we observed from our sample is that there is a predisposition to manage the farm in an independent way, that is, the grower is often the only figure that takes decisions independently or maybe in consultation with his/her relatives.

About farm management upgrading and problem solving arose that growers do not use the website and do not consult external advisors. The sample shows interests in consulting experts only for fertilization and *Psa* control. They do not get new information concerning the pollination, bio stimulants usage and most importantly, they do not ask information about increasing their productivity. Overall, results demonstrate that growers are suspicious and adverse in including information from outside. It might be related with the age or with their educational level but, the management body of several kiwifruit farms appeared to be undeveloped and disorganized.

Farm technical practices

In this section, we discuss about technical practices used in the cultivation of kiwifruit which are fundamental to reach consistent yield and quality. 14 statements were used to measure the degree of the execution of certain farm technical practices. In Appendix III (Question 16), there are two Tables showing the mean, mode and missing answers.

Starting with selecting the canes during winter pruning, 77% of them said that they always do it. Thus,

this practice seems to be accepted and implemented by the majority of the famers. Slightly fewer growers do prune kiwifruit vines during summer, 34.4% revealed that they never or rarely do it. Also our growers do not implement gel-pruning, tip-squeezing and girdling techniques. These practices are often implemented to improve fruit size and quality but they are very costly and time consuming.

Flowers and fruit thinning are practices that almost everybody does. They are fundamental to balance the number of fruit per plat in order to reach commercial size fruits. Thinning fruit and flowers is implemented by 88.9% of the respondents. Similarly, when we asked whether they use more pollinations techniques or not, 59% of the respondents said that they always apply artificial pollens to increase the fruit size.

Concerning the question "I analyse soil and leaves", the majority of them answered that they often or more than often analyse the soil and leaves. However, still there are 30.6% of the growers that rarely or never do it. Following the questions, we asked whether they supply the correct fertilizer in each physiological phase, and 84.1% of them said that they apply the correct fertilizer in each physiological phase more than often and/or always.

Avoiding water stress after fruit set to stimulate fruit growth is carried by 76.6% of them that say always avoid water stress. About the use of bio-stimulants, 66.1% of the growers expressed that they never use these products, some of them say sometime, and 19.3% use bio stimulants more than often and/or always.

Lastly, we investigate the practices concerning pest and diseases management with particular attention to the practices adopted to contain *Psa*. In the question "I constantly monitor the orchard from *Psa* symptoms", 69.4% say always and 12.9% say more than often. This tendency supports the particular attention given by the growers on the disease. Also, when we ask "I immediately remove the infected parts", a significant majority respond that always do it.

Concluding remarks on farm technical practices

From these variables concerning the implementation of the fundamental agricultural practices to cultivate kiwifruit, we saw a general tendency in often and/or always applying some practices, while others seem to be implemented less. Our sample of growers always does winter pruning, but not many growers do summer pruning, gel-pruning, tip-squeezing, or girdling. This means that they do not implement practices to optimize the partitioning of carbohydrate to fruit and as a result, they penalize the final size and quality. Also, from the face to face interviews conducted, several growers were not even aware of the girdling and tip-squeezing techniques.

Concerning fruit and flowers thinning practices, the sample shows more predispositions in doing it; however, only 59% often and/or always do artificial pollination. These two practices are interrelated. Artificial pollination makes possible the fructification per m² of canopy, whereas flower and fruit thinning balance fruit load which is crucial to reach optimal quantity/quality. It is clear that these two practices should always be conducted, however, within our sample there are still growers not doing them.

In the same way, analysis of soil and leaves is not held by all the growers. Being able to read the analysis requires specialized and agricultural educated growers, yet those prerequisites are lacking in our sample. Therefore, more skilled people who are able to interpret soil and leaves results are needed.

With regard to avoiding water stress, the majority of the population do it. However, concerning the use of bio stimulants there are some controversies. Some products are not allowed in the Zespri production guidelines because they leave residues and reduce the dry matter (taste) of kiwifruit. Consequently, lots of growers demonstrated certain reluctance in answering this question. Lastly, the sample demonstrates to be very attentive concerning *Psa* outbreak, and the majority of them implement the practices suggested.

Chain factors

Zespri quality guidelines dissemination

To understand whether cooperatives inform kiwifruit growers with technical advice that respect Zespri quality standards, we decided to include this question within the questionnaire. 81% of the growers agreed or completely agreed with it.

Chain services satisfaction

With regard to the technical services offered by the cooperative, Zespri and suppliers, here we tested the level of satisfaction of our sample. The illustration showing tendencies of these variables are in Appendix III (Question 21a, 21b and 21c). Generally growers are quite satisfied about the technical support furnished by cooperatives since 76.5% of them strongly agree and/or agree on the statement "I am satisfied with the technical support provided by my cooperative". Similarly, concerning Zespri's technical support 66.6% of the respondents express similar opinions. The tendency is different from the technical support provided by the suppliers of agricultural products. Only 29.3% agreed and/or strongly agree with it. Concerning the field days, meetings, farm excursion and so on, organized by the cooperative, respondents show a more neutral tendency of satisfaction, which is similar for the Zespri initiatives. The illustrations are reported in Appendix III (Question 21d and 21e).

Information transparency and trust in the chain

Information transparency within the kiwifruit chain is measured through a series of statements. We asked directly how transparent the information from the cooperatives are and whether they are satisfied. At the same time, we tested more deeply this aspect of the chain by asking whether they know who the cooperative's buyers are and whether they know the price at the bulk market.

In general, it is emerged that the growers consider the information transparent provided by the cooperative (Figure 24) and they are satisfied about the market information furnished by Zespri (Figure 25). However, as we can see in Figures 26 and 27 that they are completely unaware of who are the cooperative's buyers and at which price the kiwifruit are sold at the bulk market. This confirms the scarce transparency within the chain with particular regards to the market and price information shared within the chain.

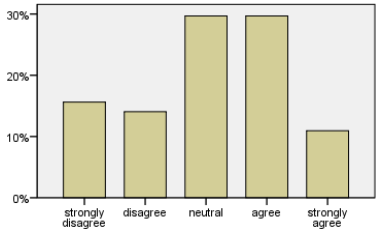

Figure 22: "The market information provided by my cooperative is transparent".

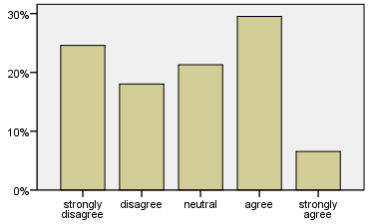

Figure 23: "I am satisfied of the market information provided by Zespri".

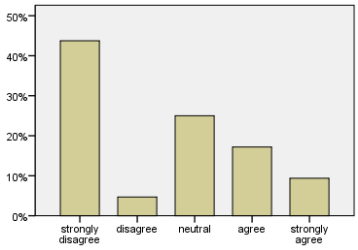

Figure 25: "I know who my cooperatives' buyers are".

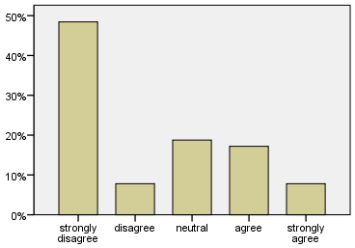

Figure 24: "I know the price of the bulk market".

To confirm these findings, we can compare the means of the questions of Figures 24 and 25 with the one of 26 and 27. They tend to be around the value three (neutral) in Figures 24 and 25 (3.06 and 2.75), and are more negative in the question 26 and 27 (2.44 and 2.28) respectively. 48.4% of the respondents disagree and/or completely disagree about "I know who the cooperative's buyers are". And similarly, 56.3% of our sample disagree and/or completely disagree with the statement "I know the price at the bulk market". These results support our first hypothesis that the information within the kiwifruit chain especially between cooperative, Zespri and growers is not transparent.

The second aspect investigated is about the trust in the kiwifruit chain. The frequencies of the answers are illustrated in Figures 26 and 27. In general, the trust in cooperatives and Zespri is overall positive although there are still about 20% of the growers that disagree with it. At the statement "I trust the technical and market information provided by my cooperative", 25% answered strongly disagree and/or disagree, 21.9% are neutral, and 53.1% agree or strongly agree (Figure 26). And in the following one about the trust toward Zespri's technical and market information, 17.7% strongly disagree and/or disagree, 29% are neutral and 53.2% agree or strongly agree (Figure 27).

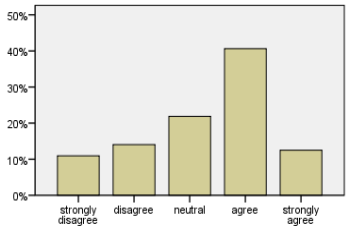

Figure 27: Question "I trust the technical and market information provided by my cooperative".

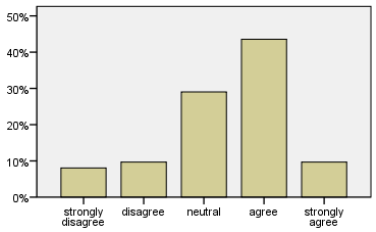

Figure 26: "I trust the technical and market information provided by Zespri".

Innovations providers

We ask our sample to choose who are the most important innovation providers by giving multiple choices answer where could fill more than one (Table 11). The results shown in table 6 explain that cooperatives and Zespri are considered the most important. Zespri and cooperatives were chosen most (31.5%) followed by other growers with 16.2%, technology sellers with 9.9%, and suppliers of agricultural products with 9%.

		Responses	
		N	Percent
Innovation providers	Growers	18	16.2%
	Suppliers	10	9.0%
	Cooperative	35	31.5%
	Zespri	35	31.5%
	Technology sellers	11	9.9%
	Others	2	1.8%
Total		111	100.0%

Table 6: Innovation providers.

Concluding remarks on chain factors

To summarize the main findings concerning chain factors, our sample seems quite satisfied about Zespri and cooperative's technical support and less satisfied about the technical supports given by the suppliers of agricultural products. With regard to the information shared upstream between growers, Zespri, and cooperatives, the opinions of our growers presented some contradictions. Growers believed that the information is transparent and sufficient but they are completely unaware of who the cooperative's buyers are and what the prices kiwifruit sold at the bulk market are. This demonstrates that market information is not transparent and openly shared between the growers. As for the trust in Zespri and cooperative, the situation is rather positive. Nevertheless, in most interviews conducted in local, kiwifruit growers verbally expressed that they don't trust completely the cooperative and only because they are the members of the cooperative should they show the trust. Overall the situation appears to be not very transparent. The general feeling of our sample towards cooperative information, such as operational costs and market information coming from downstream are rather suspicious. However, questions used in this study did not really clarify and explore the issue of Zespri, cooperative, and interactions between kiwifruit growers.

Growers' attitudes

Satisfaction level

In Figure 28, we present the level of satisfaction of the growers concerning the actual production. Overall the sample shows a certain level of dissatisfaction. From the cumulative percentage, it appeared that 50% of them are very unsatisfied and/or unsatisfied. However, the most frequent answer is satisfied and only a few cases showed to be very satisfied (11.4%) and completely satisfied (2.9%). The validity of this question presents some limitation for the reason that when we design the Likert scale we mistaken in dividing equally the satisfaction level in five equal options. The answer satisfied should have been located at the fourth level and not at the third one where a neutral option should have used.

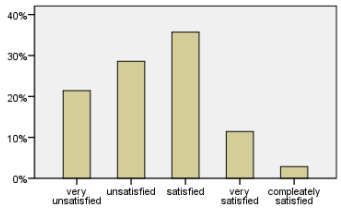

Figure 28: Satisfaction level of the growers concerning the actual production.

Future perspectives

We asked how they see the future prospects of their farm. Among the five options offered, the most frequent answer is neither black nor bright. 20% of the respondents see their future perspective as very black and/or black. In contrast, 35% see the future as bright and only 2.9 % as very bright.

In the next question, we provide five options which describe the future possibilities of the farm in the next five years, that are: a) land sold and retired, b) land transferred to the next generation, c) still farming kiwifruit but with significant income from off-farm work, d) still farming kiwifruit with significant income from farm activities, and e) still farming kiwifruit as main activity. Most of the

respondents choose the option "Still farming kiwifruit" as a main activity (42.9%) and "Still farming kiwifruit with significant income from farm activity" (24.3%). This reflects the importance of kiwifruit in generating interesting incomes within the population examined.

Willingness to cooperate

To understand our sample's intention towards a more effective communication and collaboration within the chain, we include two questions in our questionnaire; one concerning the collaboration with the cooperative and the other one refers to Zespri.

There is a strong tendency that reflects the positive intentions to collaborate more with both organizations. Both frequencies are illustrated in Figure 29 and 30. 90.6% of the respondents strongly agree and/or agree on collaborating more with their cooperative and 90.3% of them express the same opinion concerning the collaboration with Zespri.

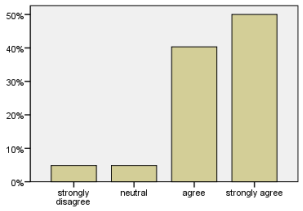

Figure 30: "I am willing to collaborate more with Zespri".

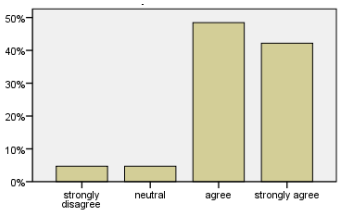

Figure 29: "I am willing to collaborate more with my cooperative".

Optional improvements

From the literature review, we have identified some programmes (initiatives) used in New Zealand to increase the farm productivity of kiwifruit growers, and to investigate whether these are applicable also in the Italian context, we convert them into statements by asking our sample to evaluate how important the programmes are for them. The three crucial programmes are based on: a) sharing knowledge and information between growers, expertise, technician, and researchers; b) visiting top-performing growers' orchard and provide evidence of the practices adopted, and c) benchmark growers' performance with other growers to stimulate inter-farm competition. The frequencies of the answered question are illustrated in Figure 31, 32, and 33.

Respondents believe that it is very important to share knowledge between growers and expertise as well as between technicians and researchers (Figure 31). Whether we sum the number of people that ranked important, very important and extremely import, we reach 98.5% of the respondents. The variable "Visiting top-performing growers' orchard and provide evidence of the practices adopted" also scored very high (Figure 32). 91.1% of the growers said that this is very and/or extremely

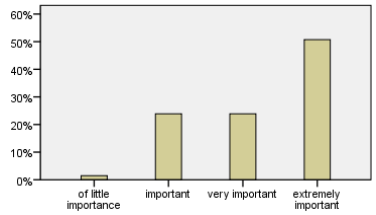

Figure 32: Importance of sharing knowledge and information between farmers, expertise, technician and researchers.

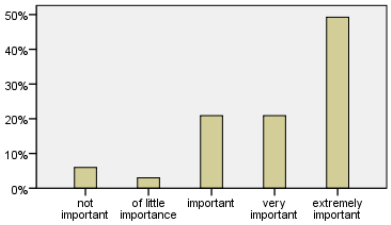

Figure 33: Visiting top-performing farmers' orchard and provide evidence of the practices adopted.

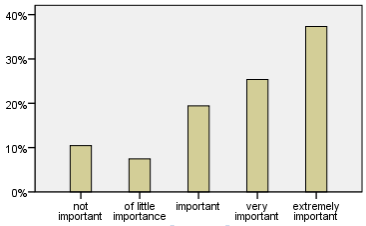

Figure 31: Benchmark your performance with the one of other growers to stimulate inter-farm competition.

important. However, from the interviews in local, several growers doubt that top-performing growers are willing to say the truth about the practices adopted. Lastly, in the question "benchmark your performance with other growers to stimulate inter-farm competition" (Figure 33), the majority expressed that it is important. But 17.9% think that it is not important or of little importance. These growers might be reluctant in sharing personal data.

Growers' responses about innovations

Four questions concerning innovations within the kiwifruit farming system were included in the questionnaire to understand general opinions about innovations. Illustrations concerning these frequencies are in Appendix III. All the growers agree and/or strongly agree about adopting innovations to increase farm productivity. Growers also showed less concerned when hiring specialized employees. Similar tendency emerge on the statement "Apply new approaches to labour use", although from the face to face interviews respondents said that this question is unclear. Lastly, the use of new varieties is seen as very important (Figure 34). 81.2% of the respondents agree or completely agree that it is important to adopt new varieties which are more resistant to *Psa*.

Educational level of the sample

The educational level of our sample is shown in Figure 34. In general, it appeared that our sample has a very low educational level. Overall the mean is 2.64 which indicate that the average education is between middle and high school. Clear evidence can be observed in the cumulative percentage of the population. 40.9% of the respondents have achieved elementary (10 years old) and middle (13 years old) school diploma, and including the one with a high school diploma, we reach the value of 84.8%. Only 15.2% have achieved a university diploma in which most cases is not agriculture related.

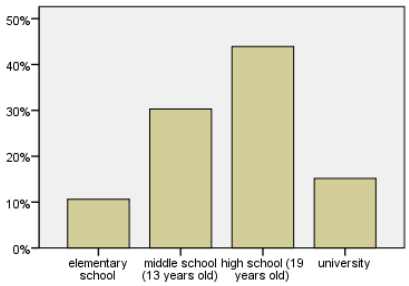

Figure 34: Educational level distribution of kiwifruit growers.

Concluding remarks on growers' attitudes

In general, the satisfaction about the actual production is rather low. A large majority of the ex-Zespri Gold kiwifruit growers faced a dramatic reduction in productivity due to the *Psa* outbreak. As a result, several growers are not satisfied. Nonetheless, the sample has a positive projection about the future. The majority see their future as not black nor bright or bright, which demonstrated a good preposition for the future. Most of the respondents answered that they will still farming kiwifruit as a main activity in the next five years. So, future perspective seems to be optimistic for them. Likewise, their willingness to cooperate more with the cooperative and with Zespri, and their positive opinions about the three programmes/initiatives to increase their productivity, and the optimistic considerations concerning four type of innovations reported, demonstrates that there is an open nature to participate in the develop the system from the growers' side .

However, when we look at the rather low education level of kiwifruit growers, some doubts arise. Our findings demonstrate that kiwifruit growers show a certain willingness to cooperate and so on, but as mentioned before, 84.8% have a limited education, and 81.8% of the population is represented by growers older than 40 years old. Also, they are less inclined to shows their outcomes and create inter-farm competition. To some extent, a rural agricultural system constituted by very old and low educated

growers might be an obstacle for the kiwifruit sector and its evolution into a dynamic global kiwifruit production system.

In addition, during the data collection phase, a scarce consideration was given the questionnaire. Most of the growers were very reluctant when we ask face to face to fill our questionnaire. And to collect 35 answered internet-based questionnaires, we sent it four times (once a week), and with reminding phone calls for them to reply. This shows rather low skills in using the computer, which is also proved by the very low use of the Zespri Canopy website. This information tool contains all possible innovations and most updated information about kiwifruit agricultural practices also translated in Italian which could be a valuable source and guidelines for the growers. But not even one third of our sample consults this website more than once a month. To conclude, the rather scarce presence of new generations associated with the opinions and characteristics of the population of kiwifruit growers make this sector behindhand and incapable to rapidly adapt to changes.

5.2 Correlation analysis

In the second part of this study, we focus on determining correlations among groups of factors according to the supposed relations discussed in Chapter 4.3. Based on the conceptual model of Figure 15, we expect find existing relationships among factors with the support of SPSS. We will first correlate primary and secondary factors with growers' productivity variables in order to identify which are positively and/or negatively influencing the productivity of kiwifruit growers. As for the second part of the analysis, attention will be placed on how primary and secondary factor do interfere each other. The correlation analysis will be explained by the numerical order from one to eleven.

Correlation and significance test

Before moving into the results interpretation and the meaning of the correlation coefficient, their significances and intensity of the association are explained. The correlation coefficients that will be calculated will be interpreted and considered in relation of their significance coefficient. The possibility that the correlation numbers could be explained by random variation or by pure chances must be reduce to the minimum, and only statistically significant correlation indexes will be discussed and taken into account. The coefficient P or Sig. describes the probability of our data not being significant due to pure chances and casual variation. The lower the significance value is, the higher the probability that our correlation coefficient does not depend on occasional chances and/or random variation is.

In our case, we will consider correlation indexes of 0.01 or below as very representative, remarkably the indexes below 0.05 and of less interest the one which are between 0.1 and 0.05. Correlation that is above 0.1 will be considered not relevant due to pure chances and therefore not explaining evident associations. In order to mark these three categories of significance indexes, they will be highlighted in red and a bigger size will be used for showing the significant relations.

The tendency of one variable to differ in relationship with another is expressed through the correlation coefficient called *r*. One can assume positive values from zero to +1 to be the case of a positive linear relationship, and negative values from zero to −1 to be the case of a negative correlation. Its intensity varies; and the more *r* assumes values around zero, the less related the two variables. Due to the large variability of our population, we labelled and categorized *r* values ≤0.25 as low or weak correlations, between 0.25 to 0.40 modest or moderate correlations, and ≥0.4 to 1.0 strong or high correlation in both positive and negative cases.

5.2.1 Interpretation of the correlation coefficients related with growers' productivity

After having elucidated the methodology applied to correlate and analyse our variables, we will now move on to the interpretation of these associations. Numerical results obtained from the analysis are shown in the correlation matrixes of Appendix VI, and the simplified version containing more significant correlations coefficient are placed next to the text. Starting with growers' productivity correlations, we include yield, dry matter and OGR of Hayward and Zespri Gold kiwifruit on the left column and the other variables (depending on the group of factor) on the horizontal row.

The correlations will follow the order:

- **Relationships 1:** 6→1 Growers' productivity vs. Chain factors.
- **Relationships 2:** 6→2 Growers' productivity vs. Growers' attitude.
- **Relationships 3:** 6→3 Growers' productivity vs. Farm characteristics.
- **Relationships 4:** 6→4 Growers' productivity vs. Farm management.

- **Relationships 5:** 6→5 Growers' productivity vs. Farm technical practices.

Relationship 1: Growers' productivity → Chain factors

Table 7 summarizes the most significant correlations coefficients identified from the association between growers' productivity and chain factors and the complete table is illustrated in Appendix VI. In general, we saw several negative relationships with very significant indexes that are not in line with our previous assumptions. Surprisingly, we expect that more satisfied growers which also trust the technical support furnished by Zespri, cooperatives and suppliers, would be positively correlated with productivity variable, but the results confirm an opposite tendency.

In particular we observed **negative** associations among (see Table 7):

- Zespri Gold yield → Question 21 A and D + Question 23 A, B, and E
- Hayward yield → Question 21 C and E + Question 23 A, B, C, D and E
- Hayward OGR → Question 23 A, B, C, D and E

From this unexpected tendency we can to a certain extent deduct that the growers with a higher yield and OGR are the one that are not satisfied of the technical support and negatively judged the variables concerning the provision of the information.

		21) In which measure do you agree with the following statements					23) Provision of the information				
Spearman's rho correlation		A) I am satisfied with the technical support provided by Zespri	B) I am satisfied with the advice provided by the suppliers of agricultural products	C) I am satisfied with my cooperative's initiatives	D) I am satisfied with the Zespri's initiatives	E) The market information provided by my cooperative are transparent	A) I know who are my cooperative's buyers	B) I know the price of the bulk market	C) I am satisfied with the market information provided by Zespri	D) I trust the technical and market information provided by my cooperative	E) I trust the technical and market information provided by Zespri
What was your **yield** of **Zespri Gold** per hectare in 2011?	*r*	**-.586****	.105	.050	**-.603****	-.282	**-.391**	**-.372**	-.313	-.283	**-.379**
	Sig	**.002**	.618	.812	**.001**	.171	**.053**	**.067**	.128	.170	**.062**
	N	25	25	25	25	25	25	25	25	25	25
What was your **yield** of **Hayward** per hectare in 2011?	*r*	-.051	.022	**-.336***	-.144	**-.467****	**-.421****	**-.264**	**-.278**	**-.359***	**-.361***
	Sig	.734	.877	**.017**	.330	**.001**	**.003**	**.067**	**.062**	**.011**	**.013**
	N	47	50	50	48	49	49	49	46	49	47
What was your **OGR** per hectare of **Zespri Gold** in 2011?	*r*	-.254	**.439***	.089	-.232	-.263	**-.355**	**-.343**	-.238	-.171	**-.330**
	Sig	.193	**.019**	.652	.235	.177	**.064**	**.074**	.222	.385	**.087**
	N	28	28	28	28	28	28	28	28	28	28
What was your **OGR** per hectare of **Hayward** in 2011?	*r*	.023	.029	-.223	.065	-.224	**-.305***	**-.349***	**-.397****	**-.453****	**-.459****
	Sig	.879	.841	.124	.668	.121	**.033**	**.013**	**.006**	**.001**	**.001**
	N	45	49	49	46	49	49	50	46	49	47

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 7: Correlations coefficients of growers' productivity and chain factors.

Relationship 2: (6-2) Growers' productivity → Growers' attitudes

Table 8 illustrates the most significant correlations coefficients identified from the association between growers' productivity and grower's attitudes. The complete correlation matrix is place in Appendix III. In particular we observed **positive** associations among (see Table 8):

- Zespri Gold yield → Question 22 A + Question 24 B
- Dry matter → Question 22 A + Question 24 B
- Gold OGR → Question 9 + Question 10 + Question 22 B + Question 24 B

We can clarify the associations by saying that growers who believe it is important to use new varieties are the one producing high yield and OGR of Zespri Gold kiwifruit. This might demonstrate how top-performing Gold growers think it is important to use new varieties. Also here it is visible that the higher the Zespri Gold OGR is the higher growers' satisfactions are, and the brighter their future perspectives are. Lastly, dry matter content seems to increase when the importance of sharing knowledge increases. This might demonstrate that through more field days and communication with external experts, the dry matter content will increase.

		9)	10)	22) Please rate the importance to you of each of the following statements		24) How important are for you the following statements?	
Spearman's rho correlation		Generally, how satisfied are you with your actual production?	Do you see the future prospects of your farm as?	A) Share knowledge and information between growers and expertise, technicians and researchers	B) Hire specialized workers to improve farm productivity	A) Apply new approaches to labour use	B) Adopt new variety
What was your **yield** of **Zespri Gold** per hectare in 2011?	*r*	.225	.121	**.361**	.283	.361	**.551****
	Sig	.249	.541	**.076**	.180	.306	**.005**
	N	28	28	25	24	10	24
What was the average **Dry Matter** at the harvest of 2011?	*r*	-.212	.024	**.344***	-.018	.019	**.239**
	Sig	.131	.864	**.015**	.905	.931	**.101**
	N	52	52	49	48	24	48
What was your **OGR** per hectare of **Zespri Gold** in 2011?	*r*	**.407***	**.453***	.101	**.323**	.478	**.512****
	Sig	**.026**	**.012**	.610	**.101**	.193	**.006**
	N	30	30	28	27	9	27

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 8: Correlations coefficients between growers' productivity and growers' attitudes.

Relationship 3: (6-3) Growers' productivity → Farm characteristics

When comparing growers' productivity factors with farm characteristics such as farm size, *Psa* outbreak infection rate, conversion phase, and the type of ownership emerged that in general there are no evident correlations. The significance indexes found are in large measure above 0.1 which means that the correlations are due to pure chances. The coefficients of the analysis conducted on these variables are illustrated in table placed in Appendix VI.

Relationship 4: (6-4) Growers' productivity → Farm management

Here we compare growers' productivity with farm management factors. Kiwifruit farm management aspects such as employees, team, decision making and use of external advisors are correlated with yield, dry matter and OGR variables. From the analysis emerged several discrepancies that are in contrast with our assumed relationships. On the one hand we observed **positive** associations among (see Table 9):

- Gold yield → Question 14 A and B + Question 17 C
- Dry matter → Question 14 A and B + Question 17 B
- Gold OGR → Question 17 C

From these positive correlations emerged the importance for Gold growers to have employees that know the practices and procedures to manage kiwifruit plants and to take decisions commonly, as well as consulting external figures to better apply bio stimulants. This is also showed in the dry matter content which is an index mostly used by the Gold growers. On the other hand, **negative** correlations coefficients arose between (see Table 9):

- Hayward yield → Question 14 A and B + Question 17 A, B and D
- Hayward OGR → Question 14 A + Question 17 A and B

Hayward growers in contrast of the gold one show less propensity in having specialized employees, take decisions together and in consulting external figures. In general, we can deduce that the presence of skilled employees and their involvement in the farm decision-making process does increase the productivity of Gold growers while negatively affect Hayward yield and OGR.

		14) Farm management		17) To what extend you make use of external advisors and to get knowledge and information concerning the following issues			
Spearman's rho correlation		A) The employees of my farm know the practices and procedures to manage kiwifruit vines	B) I always take decision in consultation with the employees	A) Managing the canopy	B) Improve pollination	C) Apply bio stimulants	D) Improve your productivity
What was your **yield** of **Zespri Gold** per hectare in 2011?	*r*	,451	,417	-,009	,093	.423*	-,177
	Sig	,060	,085	,964	,651	,031	,396
	N	18	18	26	26	26	25
What was your **yield** of **Hayward** per hectare in 2011?	*r*	-.461**	-.324*	-.291*	-.423**	,071	-.350*
	Sig	,002	,036	,050	,003	,637	,017
	N	44	42	46	46	47	46
What was the average **Dry Matter** at the harvest of 2011?	*r*	.333*	,303	,171	.297*	,110	,062
	Sig	,041	,068	,245	,040	,453	,673
	N	38	37	48	48	49	48
What was your **OGR** per hectare of **Zespri Gold** in 2011?	*r*	,160	,154	,152	-,126	.600**	-,149
	Sig	,500	,517	,431	,514	,001	,448
	N	20	20	29	29	29	28
What was your **OGR** per hectare of **Hayward** in 2011?	*r*	-.335*	-,169	-.298*	-.294*	,179	-,158
	Sig	,026	,290	,047	,050	,235	,299
	N	44	41	45	45	46	45

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 9: Correlations coefficients between growers' productivity and farm management factors.

Relationship 5: (6-5) Growers' productivity → Farm technical practices

In this section, we correlate growers' productivity with farm technical practices to understand whether farm technical practices improve the yield, dry matter and OGR of kiwifruit growers. Overall these findings confirm our assumptions that the more often these practices are implemented, the higher the productivity is. This relationship is also confirmed by the absence of significant negative correlations between farm technical practices and growers' productivity. The most significant **positive** correlations identified are between (see Table 10):

- Gold yield → Question 16 B and F
- Dry matter → Question 16 B and H
- Gold OGR → Question 16 F
- Hayward OGR → Question 16 D, E and F

Relating to Table 10, gel pruning practices is positively correlated with an *r* of 0.511 (Sig=0.009) with Zespri Gold yield, and with and *r* of 0.425 (Sig=0.003) with dry matter. The use of bio stimulants plays also a crucial role in increasing the productivity of both Zespri Gold and Hayward growers. This is demonstrated by the coefficients *r* of 0.444 (Sig=0.023) and 0.285 (Sig=0.052) for both Zespri Gold and Hayward yield, and the *r* coefficients of 0.656 (Sig=0.000) and 0.406 (Sig=0.005) for the Zespri Gold and Hayward OGR.

In particular it emerged that gel pruning techniques seems to increase the Zespri Gold yield, dry matter and OGR. This is a rather expensive practice that is mostly carried out on Zespri Gold variety due to the higher prices obtained. Plus the uses of bio stimulants increase yield and OGR of both varieties.

Spearman's rho correlation		16) Please rate how often do you use these practices							
		A) Carefully select the canes	B) I do gel pruning	C) I do flowers and fruit thinning	D) I use more pollination techniques (artificial)	E) I avoid water stress after fruit set	F) I use bio stimulants to increase fruit size	G) I immediately remove the infected parts	H) I apply pesticides according to Zespri guidelines
What was your **yield** of **Zespri Gold** per hectare in 2011?	*r*	,063	**.511****	,159	,128	-,068	**.444***	,111	-,108
	Sig	,764	**,009**	,437	,553	,740	**,023**	,599	,601
	N	25	25	26	24	26	26	25	26
What was your **yield** of **Hayward** per hectare in 2011?	*r*	-,069	,009	**-,258**	,163	,120	**,285**	-,153	-,180
	Sig	,647	,951	**,077**	,274	,417	**,052**	,315	,232
	N	47	45	48	47	48	47	45	46
What was the average **Dry Matter** at the harvest of 2011?	*r*	,061	**.425****	,023	-,095	-,147	-,105	**,263**	**.289***
	Sig	,685	**,003**	,873	,527	,312	,473	**,074**	**,047**
	N	47	46	49	47	49	49	47	48
What was your **OGR** per hectare of **Zespri Gold** in 2011?	*r*	,090	**,365**	,085	,137	,298	**.656****	,083	-,286
	Sig	,648	**,056**	,659	,495	,116	**,000**	,676	,132
	N	28	28	29	27	29	29	28	29
What was your **OGR** per hectare of **Hayward** in 2011?	*r*	**,264**	,095	,176	**.325***	**.342***	**.406****	-,103	-,197
	Sig	**,076**	,534	,238	**,027**	**,018**	**,005**	,506	,195
	N	46	45	47	46	-,068	**.444***	,111	-,108

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 10: Significant correlations coefficients between growers' productivity and farm technical practices factors.

Concluding remarks on factors impacting on growers' productivity

In general, we found some discrepancies which are not in accordance with our assumptions. In particular, Hayward and Zespri Gold yield variables show negative correlations with chain factors and management factors variables. A further check on the SPSS database was processed with special attention to the yields data, but there were not mismatches compared with the original data from the questionnaire. One way to reason it is to consider the rather high variability of our sample, the limited number respondents, and to the *Psa* outbreaks which has seriously modified the productivity of several farms. So not clear evidence have been noticed on how farm management influence growers' productivity.

Moving to the personal characteristics correlated with growers' productivity, it is clear that OGR and yield of Zespri Gold is positive associated with satisfaction level and with future perspective and importance in adapting new varieties. So the higher their OGR is, the more satisfied and positive the growers are. Moreover, another interesting relationship emerging from the analysis is about dry matter. The more growers believe that it is important to share knowledge with external experts, the higher the dry matter is. This illustrates an interesting aspect about quality.

As discussed above, farm management factors do have some contradicting results when associated with Hayward yield and OGR. In general, we can deduce that the presence of skilled employees and their involvement in the farm decision-making process are positively associated with the productivity of Zespri Gold, while it is not the case with Hayward yield and OGR. The use of external advisors concerning the use of bio stimulants is significantly positive in increasing Zespri Gold and Hayward yield and OGR.

Lastly when we associated growers' productivity with farm technical practices arose that when these practices are held, the productivity rise as well. This is confirmed by the general essence of negative correlation coefficients. Due to the variability of our sample the *r* coefficient are not very significant and strong apart gel pruning and use of bio stimulants. Gel pruning technique is positively associated with Zespri Gold yield and with dry matter. And the use of bio stimulants presents very high *r*

coefficients with Zespri Gold and Hayward yield and OGR. So, these two practices appeared to be the most influential in altering the productivity of kiwifruit.

5.2.2 Interpretation of the relationships between primary and secondary factors

After having described the variables affecting kiwifruit growers' productivity, we move our attention on how secondary and primary factors influence each other. By referring to conceptual model of Figure 13, chain factors and growers' attitudes will be correlated with farm management and farm technical practices; and farm characteristics factors will be correlated with farm management factors that we also assume influence farm technical practices. Following the same organization used above, correlation tables which report significant relationships are illustrated next to the text and the complete correlation matrixes are in Appendix VI. Here we will discuss the associations six to 11.

- **Relationships 6:** 1→4 Chain factors vs. Farm management.
- **Relationships 7:** 1→5 Chain factors vs. Farm technical practices.
- **Relationships 8:** 2→4 Growers' attitudes vs. Farm management.
- **Relationships 9:** 2→5 Growers' attitudes vs. Farm technical practices.
- **Relationships 10:** 3→4 Farm characteristics vs. Farm management.
- **Relationships 11:** 4→5 Farm management vs. Farm technical practices.

Especially in this part of the analysis emerged that there are several correlations with moderate significance and *r* coefficients. To make the analysis clearer, we identify certain tendencies in the matrixes which are showing interesting associations, as well as by referring and discussing those that present reasonable reasons behind.

Relationship 6: (1-4) Chain factors → Farm management

From the association illustrated in Table 11 where we associate chain and farm management factors, it appears that all relations coefficients are positive. This demonstrates that chain factors and farm management are closely interdependent and that the increase of one causes an increase of the other as well. By focussing on the significant associations and at their trend we can highlight a few interesting **positive** associations among (see Table 11):

- Question 14 C → Question 20 + Question 21 A and C + Question 23 B and D
- Question 15 → Question 23 B, C, D and E
- Question 17 A → Question 20 + Question 21 D and E + Question 23 A, B, C, D, and E
- Question 17 B → Question 21 A, D and E + Question 23 A, B, C and D

The first association demonstrates that the stronger the team is the more satisfied the growers are of the cooperative support and the more information concerning the price at the bulk market they know. Thus, growers that possess a management team are more satisfied and aware of the information.

The second interesting inclination is about the use of Zespri canopy website. This relation confirms that growers who visit the website tend to know more information from the chain and as a result show trusts in these organizations.

Table 11 also shows other positive correlations concerning the use of external advisors to get knowledge and information concerning the control of *Psa* and the increase of productivity. It emerged that the more information growers ask to external advisors about the *Psa* control, the more satisfied about cooperatives and Zespri initiatives they are, and furthermore the more information they have and the more trust they express. Regarding the use of external advisors to get knowledge and information

concerning the improvements in the productivity, it is positively correlated with satisfaction versus cooperative and Zespri initiatives, knowledge about the cooperative's buyer and about the price at the bulk market. And lastly it is correlated with satisfaction towards Zespri information and trust towards technical and market information provided. As a result, the growers that want to do better and improve their productivity are the ones that positively consider the chain factors.

Spearman's rho correlation		14) Farm management			15)	17) To what extend you make use of external advisors to get knowledge and information concerning the following issues	
		A) I rely mostly on permanent (specialized) employees	B) The employees of my farm know the practices and procedures to manage kiwifruit vines	C) We have a good team that jointly resolve operational problems	How often do you visit the Zespri Canopy website	A) Deal with *Psa*	B) Improve your productivity
20 My cooperative informs me about the Zespri guidelines concerning the quality standards?	*r*	.324*	,241	.328*	,055	.347**	,194
	Sig	,028	,091	,020	,718	,008	,148
	N	46	50	50	46	58	57
21 A) I am satisfied with the technical support provided by my cooperative	*r*	,266	.295*	.291*	,159	,219	.321*
	Sig	,071	,036	,038	,292	,096	,014
	N	47	51	51	46	59	58
21 B) I am satisfied with the technical support provided by Zespri	*r*	-,102	-,055	-,055	,079	,215	,167
	Sig	,514	,710	,713	,600	,114	,228
	N	43	48	48	47	55	54
21 C) I am satisfied with the advice provided by the suppliers of agricultural products	*r*	,150	,212	.313*	-,018	-,012	,245
	Sig	,308	,132	,024	,908	,928	,062
	N	48	52	52	46	60	59
21 D) I am satisfied with my cooperative's initiatives	*r*	.312*	,210	,208	-,040	.354**	.308*
	Sig	,032	,140	,142	,790	,006	,019
	N	47	51	51	46	59	58
21 E) I am satisfied with the Zespri's initiatives	*r*	,154	-,056	-,011	-,109	.388**	.310*
	Sig	,325	,706	,940	,464	,003	,023
	N	43	48	48	47	55	54
23 A) I know who are my cooperative's buyers	*r*	,129	,166	,137	,246	.280*	.268*
	Sig	,387	,249	,339	,103	,033	,044
	N	47	50	51	45	58	57
23 B) I know the price of the bulk market	*r*	,136	.344*	.368**	.447**	.292*	.404**
	Sig	,367	,016	,008	,002	,027	,002
	N	46	49	51	45	57	57
23 C) I am satisfied with the market information provided by Zespri	*r*	,040	,111	,157	.336*	.371**	,262
	Sig	,799	,463	,286	,024	,006	,056
	N	43	46	48	45	54	54
23 D) I trust the technical and market information provided by my cooperative	*r*	,176	.287*	,242	.304*	.412**	.310*
	Sig	,236	,043	,087	,042	,001	,019
	N	47	50	51	45	58	57
23 E) I trust the technical and market information provided by Zespri	*r*	,053	,139	,131	,256	.354**	,195
	Sig.	,733	,350	,370	,085	,008	,154
	N	44	47	49	46	55	55

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 11: Correlations coefficients between chain factors and farm management factors.

Relationship 7: (1-5) Chain factors → Farm technical practices

From the correlation of these two groups of factors arose some dispersed positive and negative correlations. By looking closely and searching for interesting associations, we did not identify remarkable associations to discuss. The correlation indexes are illustrated in Appendix III.

Relationship 8: (2-4) Growers' attitudes → Farm management

From the comparison between growers' attitudes and farm management factors we saw interesting tendencies among (see Table 12):

- Question 26 → Question 14 A, C
- Question 30 → Question 13 + Question 14 A, B, C
- Question 14 C → Question 22 A, B, C + Question 23 A, B + Question 24 A, B, C + Question 30
- Question 22 A → Question 14 B, C + Question 17 A, B, C, D, E

Starting with growers characteristics such as the age, we found two negative correlations that prove that the higher the age is, the lower the reliance on specialized employees is (r=0.398 Sig=0.003) and the less decisions taken in consultation with the employees are (r=0.398 Sig=0.003). This demonstrates the tendency in which older growers are more sceptical in hiring specialized people and in relying on them. Next to this, we found that educational level does have an effect on the way the farm is managed with special concern about the presence of specialized employees. Schooling level is positive associated with the number of permanent employees (r=0.444 Sig=0.004), with the reliance on them (r=0.320 Sig=0.025), the consideration that these employees know how to manage kiwifruit vines (r=0.398 Sig=0.003) and with the fact that the growers tend to take decisions in consultation with them (r=0.373 Sig=0.006). As a result, the more educated are the growers the more specialized, solid, and consistent the farm management is. An additional finding is about the variable "I always take decision in consultation with the employees" which is positively correlated with several variable of the growers' attitudes, and negatively associated with age and years of experience in cultivating kiwifruit. Hence, growers who work cohesively with their employees in their management structure are the ones that are optimistic on possible improvements, innovations and also are the ones that are more educated. Lastly, we saw an interesting trend between sharing knowledge between growers and expertise (22 A) with the question 17 about the use of external advisors concerning different agricultural issues. The more important is for the growers to share knowledge about agricultural issues and the more they ask information to external experts.

Spearman's rho correlation		13)	14) Farm management			17) To what extend you make use of external advisors to get knowledge and information concerning the following issues				
		How many permanent employees do you have?	A) I rely mostly on permanent (specialized) employees	B) The employees of my farm know the practices and procedures to manage kiwifruit vines	C) I always take decision in consultation with the employees	A) Improve pollination	B) Fertilization management	C) Apply bio stimulant	D) Deal with *Psa*	E) Improve your productivity
22 A) Share knowledge and information between growers and expertise, technicians and researchers	*r*	,190	,085	.306*	.334*	.275*	.276*	.258*	.382**	.294*
	Sig	,240	,567	,026	,016	,032	,032	,043	,002	,021
	N	40	48	53	51	61	60	62	61	61
22 B) Visiting top-performing growers' orchard and provide evidence of the practices adopted	*r*	,214	,094	,209	.329*	.310*	,052	-,029	.301*	,225
	Sig	,184	,527	,132	,019	,016	,694	,825	,019	,083
	N	40	48	53	51	60	59	61	60	60
22 C) Benchmark your performance with other growers to stimulate inter-farm competition	*r*	,181	,245	,142	,234	.310*	,160	,055	,154	.315*
	Sig	,263	,094	,309	,098	,016	,225	,671	,240	,014
	N	40	48	53	51	60	59	61	60	60
23 A) I am willing to collaborate more with my cooperative	*r*	,173	,184	,187	.288*	,184	-,016	,103	,065	,174
	Sig	,294	,217	,193	,045	,160	,906	,428	,620	,185
	N	39	47	50	49	60	59	61	60	60
23 B) I am willing to collaborate more with Zespri	*r*	,046	,192	.335*	.491**	,224	,149	,095	.338**	,259
	Sig	,789	,211	,022	,001	,091	,268	,478	,010	,051
	N	37	44	47	46	58	57	58	58	57
24 A) Hire specialized workers to improve farm productivity	*r*	,093	.430**	,233	.471**	.295*	,147	-,049	,219	.298*
	Sig	,575	,002	,097	,000	,029	,288	,720	,108	,027
	N	39	48	52	51	55	54	56	55	55
24 B) Apply new approaches to labour use	*r*	,195	,344	,325	.429*	,185	.265*	-,050	,078	,143
	Sig	,339	,058	,074	,014	,165	,046	,705	,561	,285
	N	26	31	31	32	58	57	59	58	58
24 C) Adopt new variety	*r*	,264	,170	,233	,267	,156	,235	,077	-,062	,285
	Sig	,105	,248	,097	,058	,393	,196	,677	,737	,114
	N	39	48	52	51	32	32	32	32	32
26 What is your age?	*r*	-,005	-,264	-,202	-.353*	,017	,152	-,128	,242	,208
	Sig	,973	,070	,151	,011	,898	,260	,333	,068	,118
	N	41	48	52	51	58	57	59	58	58
29 How many years have you been working in kiwifruit farm?	*r*	,137	-,255	-,140	-.325*	-,069	-,036	,155	-,106	-,212
	Sig	,394	,080	,323	,020	,607	,791	,242	,430	,111
	N	41	48	52	51	58	57	59	58	58
30 What is your education level?	*r*	.444**	.320*	.398**	.373**	,189	,116	-,036	,151	,194
	Sig	,004	,025	,003	,006	,144	,379	,779	,244	,135
	N	41	49	53	52	61	60	62	61	61

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 12: Correlations coefficients between growers' attitudes and farm management factors.

Relationship 9: (2-5) Growers' attitudes → Farm technical practices

From this association there are several correlations that were founded not really plausible. So we decide to exclude them from the discussion and report the original table which is illustrated in Appendix VI.

Relationship 10: (3-4) Farm characteristics → Farm management

From the associations illustrated in Table 13 we identified two important affinities that clarify how the management aspects investigated are positively correlated with the farm size. These relations can be seen among (see table 13):

- Question 2 → Question 13 + Question 14 C + Question 17 B, C, D
- Question 3 → Question 13 + Question 14 A, B, C + Question 17 A, B, D

A very significant correlation is visible between the total farm size and number of permanent employees (r=0.7 Sig=0.000). Aside from that, we found that larger farms tend to have employees that know practices and procedures to manage kiwifruit vines (r=0.327 Sig=0.008), a good team that jointly resolve operational problems (r=0.7 Sig=0.000), and takes decisions in consultation with their employees (r=0.7 Sig=0.000). Moreover, as we can see in Table 13 farm size is positively associated

with the use of external concerning canopy management (r=0.7 Sig=0.000), fertilization management (r=0.7 Sig=0.000), and on improving the productivity (r=0.7 Sig=0.000). This demonstrates that the larger farms are the more permanent employees they have, and the more jointly daily problems are solved and the more external advisors are consulted. Thus, although we did not find significant differences between large plantation and smaller one in terms of OGR and yield of both Zespri Gold and Hayward variety (maybe due to *Psa*), here emerged that the way kiwifruit farms are managed differ on the farm size.

Spearman's rho correlation			14) Farm management			17) To what extend you make use of external advisors to get knowledge and information concerning the following issues			
		13 How many permanent employees do you have?	A) The employees of my farm know the practices and procedures to manage kiwifruit vines	B) We have a good team that jointly resolve operational problems	C) I always take decision in consultation with the employees	A) Managing the canopy	B) Fertilization management	C) Apply bio stimulants	D) Improve your productivity
2 How many hectares of Hayward did you have in 2011?	*r*	**.697****	.176	.176	**.277***	.248*	**.353****	**.335****	**.343****
	Sig	**.000**	.124	.121	**.036**	.047	**.008**	**.010**	**.009**
	N	32	45	46	43	47	46	48	47
3 What is your total farm size (ha)?	*r*	**.700****	**.327****	**.462****	**.417****	**.339****	**.321****	.160	**.341****
	Sig	**.000**	**.008**	**.000**	**.001**	**.004**	**.006**	.107	**.004**
	N	41	54	55	52	61	60	62	61

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 13: Correlations coefficients between farm management and farm characteristics factors.

Relationship 11: (4-5) Farm management → Farm technical practices

In the last relationship calculated we compare farm management and farm technical practices factors (Table 14). The main tendencies identified are between (see Table 14):

- Question 13 → Question 16 A
- Question 14 → Question 16 A, B, C, D, G
- Question 17 A → Question 16 D
- Question 17 B → Question 16 E, F, G

What we saw from this relationship matrix is that the more permanent employees the farms have the more frequent the girdling practices are implemented. In general sophisticated practices such as gel pruning, tip-squeezing and girdling are positively associated with the number of employees and with the variable "I always take decision in consultation with the employees". But also that the more frequently farm technical practices are implemented, the more inclined the grower asking advice concerning their implementation; and/or vice versa. This is shown in the correlation between "I use bio stimulants to increase fruit size" with "I use external advisors to get knowledge and information about how to apply bio stimulants" (r=0.676 Sig=0.002). And similarly, the variable "I apply pesticides according to Zespri guidelines" with the three practices adopted to contain *Psa*.

Spearman's rho correlation		16) Please rate how often do you use these practices						
		A) I do gel pruning	B) I do tip-squeezing	C) I do girdling	D) I use bio stimulants to increase fruit size	E) I constantly monitor the orchard from *Psa* symptoms	F) I immediately remove the infected parts	G) I apply pesticides according to Zespri guidelines
13 How many permanent employees do you have?	*r*	.039	.266	**.486****	-.178	-.168	-.116	.207
	Sig	.413	.058	**.002**	.147	.161	.250	.113
	N	34	36	35	37	37	36	36
14 I always take decision in consultation with the employees	*r*	**.269***	**.273***	**.314***	**-.302***	-.009	.245*	**.277***
	Sig	**.034**	**.030**	**.016**	**.018**	.475	.047	**.028**
	N	47	48	47	48	48	48	48
17 A) Apply bio stimulants	*r*	.167	**-.261***	-.226*	**.676****	-.100	-.153	-.143
	Sig	.105	**.023**	.044	**.000**	.220	.121	.135
	N	58	59	58	62	62	60	61
17 B) Deal with *Psa*	*r*	.044	.090	.143	-.072	**.285***	**.278***	**.472****
	Sig	.371	.249	.142	.290	**.013**	**.016**	**.000**
	N	58	59	58	61	61	60	61

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 14: Correlations coefficients between farm management and farm technical practices factors.

6 Discussion

Referring to the outcomes obtained and described in the results analysis chapter, we now move our attention to the interpretations based on our research objective, the literature review and on the methodology applied.

First of all, it is interesting to consider the main characteristics of the sample studied. The kiwifruit growers investigated are located mostly in the center of Italy and are in large measure represented by small and medium size family owned farms with two/three hectares. The two most common kiwifruit varieties of our sample are Zespri Gold and Hayward. Overall our sample is composed by growers rather aged for the reason that 82% of them are over 40 years old. And clear evidence emerged when we saw that 40% of the respondents have achieved only elementary (10 years old) and middle (13 years old) school diploma which reflect the low educational level of the sample. From this preliminary description of the sample investigated, it is evident that growers' age and education might be two limiting aspects affecting the collaboration within the chain, and in particular the interaction with experts and peers as supported by Kilpatrick (2000).

Another findings concern the variability of our sample which appear to be more evident in some variables and less in others. For instance, concerning the productivity, some Zespri Gold kiwifruit growers had an OGR below 5,000 €/ha in 2011 whereas other growers far exceed 40,000 €/ha. Another variability found is in the farm size. Within our respondents there are farms of one hectare and other of 220 hectares. One of the causes of the variability concerning the productivity is related to the *Psa* outbreak. This disease has seriously changed the sector and compromised the productivity of Zespri Gold farmers as we saw in 59% of our sample which experienced a decreased in productivity of about 30 to 100% between 2009 and 2011.

With regard to our objective of the study to *"provide recommendations on opportunities for productivity improvements of the Italian Zespri kiwifruit chain by investigating how farm management practices and chain players related activities have positive or negative effect on growers' performance"*, we found evident limitations (negative effects) in the way farms are managed. Within our sample we saw that the farm management team is mostly constituted by the single grower that own the farm and that relies on labour forces (largely family members) in specific periods of the year. From the survey, 53% of our respondents completely disagree and/or disagree on relying on permanent (specialized) employees. As remarked by Patterson and Currie (2010), specialized workers are needed to achieve high numbers of commercial fruit. Thus, scarce presence of specialized employees might be a limitation of their productivity. Also, 61% of the respondents strongly disagree and/or disagree in including their employees in the decision-making process. An opposite tendency arose within large plantations. From the correlation between farm characteristics and farm management we found positive correlation coefficients between farm size and permanent employees number (r=0.7 Sig=0.000), and with the variable involving them in the decision-making process (r=0.417 Sig=0.001). We can translate this aspect by saying that only medium/large size plantations possess a management team based on experienced employees, and rarely smaller farms are able to maintain permanent employees all year long. This is also due to the seasonality of the labour request in a kiwifruit farm which fluctuates with picking at the harvesting time, winter pruning and so on during the year.

Another trend that might negatively influence growers' productivity is that only few growers rely on external experts and/or other information tool to get technical assistance in the day-to-day farming

decisions. From the 50 growers out of 74 that answered the question about the use of the Zespri website, 56% of them visit the Zespri website every six months or less. This also confirmed by the low requests of asking advice from external expert. From the analysis emerged that the sample do not ask advices about canopy management, pollination, use of bio stimulants, and about how to improve the orchard' productivity. The only issue in which our respondents tend to consult experts is the *Psa* management and control. 70% of the growers interviewed contact technicians and ask information about *Psa* at least once a month and/or once a week. Concerning this aspect, we saw more predispositions from the grower side in updating his/her knowledge. In line with Kilpatrick (2000) and with other literature findings, it is the combination of inputs managed by the grower who has more production-relevant education and/or information that can produce more output. The overall tendency in the sample studied is that kiwifruit growers are not very open to get assistance from outside which appeared to be different concerning the *Psa*.

The last factor of the farm management practices that we saw and that may negatively influence the growers' productivity concerns the technical practices adopted to cultivate kiwifruit. The sample implement only basic technical practices such as winter pruning, flowers and fruits-thinning, artificial pollination (not always), fertilization and *Psa* monitoring. While it does not apply more sophisticated and expensive techniques i.e. summer pruning, girdling, tip-squeezing used to enhance the distribution of carbohydrate to fruit with consequent improve in quality and quantity. As a result, high productivity outcomes are hardly achievable (Patterson & Currie, 2010). This might depend on the scarce presence of specialized (permanent) employees that are needed to execute such laborious practices or to the limited resources and knowledge of the large majority of growers interviewed.

With regard to the chain players activities and interests, we saw that the technical services offered by the cooperative, Zespri and suppliers, might positively influence growers performance. Our respondents' outcomes showed to be satisfied about the services provided by the cooperative, Zespri, and slightly less about the services offered by their suppliers. The studied sample also shows a positive satisfaction concerning field days, meetings, farm excursions organized by cooperative and Zespri. This reflects the general opinion of the sample concerning the technical support offered. However, in the analytical phase we did not find significant correlations coefficients which demonstrate that satisfied growers tend to produce more.

An additional chain aspect that might interfere with growers productivity emerged from our findings when we test the transparency of the information shared between growers, cooperatives and Zespri. It appeared that although growers considered the information provided by the cooperative transparent, and they are satisfied about the market information given by Zespri; they are completely unaware of who are the cooperative's buyers and at which price their kiwifruit at the bulk market is sold. 48% of them disagree and/or completely disagree on "I know who the cooperative's buyers are", and similarly, 56% disagree and/or completely disagree on "I know the price at the bulk market". These results confirm the scarce transparency within the chain, with particular regards to the market and price information shared between cooperatives, Zespri and growers. Furthermore, we found that our sample trust cooperatives and Zespri which is in a complete contradiction with what we saw in the literature. Akkermans *et al.,* (2004) define the information transparency within the chain as *"the result of reinforcing dynamic interactions between trust levels of chain partners"*. In our case the information seems to be not transparent, but the trust level is high. One way of interpreting this contradiction is that respondents do not fully trust the system but they do not have any other alternatives (limited

competitions among cooperatives or pack-houses). Another explanation could be that they do not really know which type of chain information should be shared. This was also confirmed from the 40 face-to-face interviews. Several interviewed answered that they have never received any sort of information about downstream passages. We suggest that further studies are needed to clarify these inconsistencies about chain information transparency within the Italian kiwifruit system.

In the survey we also look at some general opinions of the grower such as satisfaction, future perspectives, importance of innovations, and the consideration about possible programmes used in New Zealand to improve kiwifruit farm productivity. It arose that 50% of our sample is very unsatisfied and/or unsatisfied, 36% is satisfied and just a few of them showed to be very satisfied about the actual production. About the future prospects of their farm, 20% of the growers see them as very black and/or black, 61% neither black nor bright, and 35% see the future as bright and only 4% as very bright. In general the population reflected certain dissatisfaction about the actual situation, while their future perspectives are seen as slightly bright.

Respondents show willingness to cooperate more with Zespri and with the cooperatives, and also think that it is important to implement the three programmes proposed and based on: 1) sharing knowledge and information between growers, expertise, technician, and researchers; 2) visiting top-performing growers' orchard and provide evidence of the practices adopted, and 3) benchmark growers' performance with other growers to stimulate inter-farm competition. The positive attitude of our sample concerning the aforementioned aspects seems to be an opportunity to implement such programmes which might develop the kiwifruit production sector and the productivity too.

Among the factors that we saw are directly influencing the productivity, we identify evident correlations which demonstrate that growers' productivity is positively associated with the following aspects:

→ *Satisfaction level*
→ *Future perspective*
→ *The importance in adopting new varieties*
→ *Farm technical practices such as: a)gel pruning b)bio stimulants*
→ *The presence of specialized employees*
→ *The involvements of employees in the farm decision-making process*

Additional consideration founded along the study can be drawn from the correlation between primary and secondary factors (Chapter 5.2.2). Although these correlations do not directly influence growers' productivity they might be indirectly related.

Between chain factors and farm management ***(Relationship 6)*** we observed that:

→ *The stronger is the team the more satisfaction the growers are about cooperative support, and the more information of bulk market price they know.*
→ *Growers that visit the Zespri Canopy website more often know more information from the chain and tend to trust more cooperative and Zespri.*
→ *Growers that use external advisors to get knowledge and information concerning the improvements in the productivity are satisfied towards cooperatives and Zespri initiatives, and they have knowledge about the cooperative's buyer and bulk market price.*

Between growers' attitudes and farm management ***(Relationship 8)*** we observed that:

→ *The higher is the age, the lower is the reliance on specialized employees and the fewer decisions are taken in consultation with the employees.*
→ *Educational level is positive correlated with the presence of specialized employees, with the reliance on them, with the fact that these employees know how to manage kiwifruit vines, and with the tendency to take decisions in consultation with the employees.*

Between farm characteristics and farm management ***(Relationship 10)*** we observed that:
→ *The larger are the farms the more permanent employees are used, the more practices they employees know and the more solid is the management team which also take decision in consultation with the employees.*
→ *The larger is the farm the more consultation is request to external advisors concerning canopy management, fertilization management, and improving the productivity.*

Between farm management and farm technical practices ***(Relationship 11)*** we observed that:
→ *The more farm-technical practices are implemented and the more inclined is the grower to ask advice concerning their implementation.*

These aforementioned associations should be taken into account when implementing intervention programmes. We found evident association that demonstrated which are the aspects that could reinforce farm management.

By moving our attention to the methodology used in this study, we can say the strategies applied (desk research combined with the survey strategy) demonstrated to be very suitable. On the one hand the desk research strategy bears a better understanding of the context and the validation of the significant theories concerned the topic; and on the other hand, the survey strategy appeared to be a robust tool to collect empirical information from our sample. It makes possible the information generation and significant evidence throughout the field data collection. We consider the strategy appropriate to the research performed for the reason that we did not encounter significant problems along the research development.

The concepts identified in the beginning which we assumed as fundamentals factors influencing growers' productivity were then grouped and used during the whole study process. Based on this assumed categorization interesting findings and specific relationships emerged from the study. However, they embraced multiple aspects of the sector which made the investigation very broad.

The conceptual model (Figure 15) designed and based on these groups of factors was then used to illustrate possible relationships of the kiwifruit farming system influencing growers' productivity. We assume that farm characteristics, farm management and farm technical practices are directly influencing the productivity (primary factor); and that, chain factors and growers' attitudes do exert a weaker effect (secondary factors) on growers' productivity. This supposition has been confirmed only for farm technical practices which showed evident positive statistical correlations coefficients with productivity. So far, farm technical factors can be considered primary in influencing growers' productivity. And concerning all other groups of variables, no evident differences appeared between primary and secondary factors in affecting the growers' productivity. These are the reasons why the conceptual model should be redesigned or tested in a bigger sample. As a consequence, our model presents limitations in exploring the causes altering the productivity of kiwifruit growers.

Some criticism concerning this study can be stressed on the way of data collection. From the several aspects identified in the literature, we designed a questionnaire focusing on six main issues (farm characteristics, farm management, technical practices, chain factors, personal characteristics and

opinions and growers' productivity). It was structured in 31 questions of which some contain sub-questions, which in total result in 69 questions that we asked to each respondent. The time needed to fill it varies from 20 to up to 40 minutes. We directly experienced that during the interview conducted in the farms, kiwifruit growers got stressed for such a long test. Also often they did not understand some questions and even more time was needed to explain it. This did not speed up the process of collecting the data. Possible improvements on the questionnaire can be done though reducing the number of questions, and by pre-testing it in a small sample located in the area for further modifications. Lastly, a reduction of the issues investigated would speed up the data collection. A shorter questionnaire focusing on less features of the kiwifruit system would increase the number of cases to a more valid statistical quantity (e.g. 200/300 kiwifruit growers), which would result in a better description of a specific phenomenon.

7 Conclusions

Based on the objective of the study, the Italian kiwifruit growers' productivity can be improved and opportunities can be recognized within the industry. The study has undergone a literature review and a survey to understand and elucidate further. From the sample examined become clearer that the ways kiwifruit farms are managed differ significantly from case to case. A panorama on 74 kiwifruit growers mostly located in the centre of Italy (Latina) verified its variability on some growers' characteristics. Significant productivity differences have been noticed in the yield, OGR of Hayward and Zespri Gold kiwifruit growers. Furthermore, *Psa* outbreak has seriously changed the sector and compromised the productivity of the majority of Zespri Gold growers since 2009.

By referring to our initial research question of *"what opportunities can be recognized within the Italian kiwifruit chain to improve the growers' productivity?",* we identify the following factors as directly related to growers' productivity.

- Farm **technical practices** such as gel-pruning are positively associated with Zespri Gold yield and dry matter, while use of bio stimulants clearly increases Zespri Gold and Hayward yield and OGR.
- Farm **management factors:** there are positive associations between the presence of specialized employees and their involvement in the farm decision-making process with dry matter and Zespri Gold yield.
- **Growers' attitudes** such as high satisfaction level, bright future perspective, and importance of using new varieties are positively correlated with dry matter and Zespri Gold yield.

Furthermore, the major weaknesses which have been identified as main opportunities to increase the productivity are in the farm management; that are, (i) the rather low educational level of the growers, (ii) the absence of management teams, (iii) the very low involvement of specialized employees in the farm decision making, (iv) the limited use of sophisticated technical practices (girdling, summer pruning, soil test etc.) used to enhance quality and quantity, (v) the low frequency of adopting Zespri Canopy website, and (vi) the low dependency on external experts, for they may all indirectly affect the productivity

To verify the above management weaknesses, we have found for some cases that when they present a well-organized management team, the growers appear to be more satisfied about the cooperative supports and more informed about the bulk market prices. We also observed significant results regarding how farm management teams gain information externally. Growers who visit the Zespri Canopy website frequently know more chain information and tend to trust the cooperatives and Zespri. Besides, we saw that growers who consult experts to gain knowledge and information about productivity improvements are more satisfied with the cooperatives and Zespri initiatives, and they know who the buyers are and bulk market prices. Lastly, growers that execute farm-technical practices more frequently are inclined to ask advice about their implementation. Additional interesting findings that might be extra opportunities for improving the growers' productivity are the characteristics of the grower. Older growers do not rely on specialized employees, and do not include employees in the decision-making process. On the contrary, highly educated growers show strong reliance on specialized employees and they are more willing to involve the employees in the decision-making process.

We found that the information within the chain is not transparent since most growers of our sample are not aware of the cooperatives' buyers and the bulk market prices. However, this contradicts to our

results of how most growers show their trust in cooperatives and Zespri while they don't know crucial information which should be shared. Therefore, improving the transparency of the information might create an opportunity to indirectly increase the growers' productivity.

To sum up, farm management should be renovated and information transparency within the chain should be enhanced as these are the opportunities for improvements. Possible solutions for these inadequacies are to share information with experts, visit top grower's farms and benchmark their outcomes, for the three programmes have been highly valued by our sample.

8 Recommendations for further research

Due to the high variability of our sample's characteristics, we encountered some difficulties testing our assumed relationships. Especially when we move to the correlation analysis, it emerged that the calculated coefficients tend to assume moderate correlations values. We believe that the limited number of cases investigated might reduce evidences to a certain extent, and that 74 respondents did limit the identification of the crucial relationships intended to examine with this study. As a consequence, we recommend researchers to further extend the data collection to a statistically sufficient number of respondents (200/300 growers). This may deliver more evidences in a variegate sample such as the Italian kiwifruit growers.

Furthermore, referring to the aforementioned statement, the conceptual model should be modified. We saw how farm technical practices emerged as main factor influencing growers' productivity. Regarding further researches with similar objective, we recommend to redesign the model by focussing on the factors impacting on farm technical practices; for instance, production costs, agronomical knowledge, specialization of the employees, etc.

Lastly, we identify interesting findings about the way kiwifruit farms are managed. In particular we saw ineffectiveness in the team composition, decision making process, specialization of the employees, the communication with external figures etc. Therefore we strongly recommend that further studies should explore more the management structure of small, medium, and large kiwifruit plantations.

9 Recommendations to the industry

After having conducted this study we believe it is fundamental to provide some recommendations to the industry players. In particular we refer to kiwifruit chain players such as growers, cooperatives and Zespri.

Recommendations to Kiwifruit Growers

To kiwifruit growers we suggest to invest more resources on the management of their farm. Improvements should be done through farm reorganization. Younger and educated agronomists should be hired and accompanied together with growers in the farm management. They will improve the communication with expert, cooperatives' technicians and with other stakeholders. We also advise them to implement more laborious and expensive technical practices, such as girdling, summer pruning, soil test, etc. which will increase quality and quantity. In conclusion, younger technicians with an agricultural background and with more competencies should be integrated in the existing farm structure in order to lift the optimization of the resources and the farm productivity.

Recommendations to Kiwifruit Cooperatives

To cooperatives we suggest to enhance the communication with growers by improving the transparency of the information together with offering technical services. Furthermore, we saw that cooperatives process, pack and store kiwifruit for Zespri and for other customers. Due to different fruit characteristics requirements, we suggest to promote specific production programmes among their associated growers. For instance, one programme could focus on producing kiwifruit according to Zespri quality parameters, and the other programme could be based on fulfilling other customers' requirements. Thus, we advise cooperatives to reinforce the information transparency by informing the associate growers about: who the customers are, which products growers should produce (in order to satisfy specific consumer), and most importantly, how to produce it.

Recommendations to Zespri

Concerning Zespri, we identify two main suggestions for improvements. As mentioned earlier, we suggest cooperatives to improve the communication with kiwifruit growers. Respondents gave positive considerations to the three optional programmes for improvements (page 47). These already applied approaches in New Zealand could be applicable also in Italy. These will principally increase the growers' competencies, stimulate growers information exchange with experts, and most importantly, it will create a transparent co-learning process which will also boost growers' performance and create inter-farm competition. This could be done through: seasonal-theme meetings, periodic farm excursions and through training courses that clarify and explain to growers how to optimizing their resources for a better kiwifruit production.

The second suggestion is about the identification, selection and retention of the best growers which can constantly supply standardized high quality kiwifruit. Although there are limited top performing cases in our study (see Chapter 5.1), we visited a few outstanding growers selling fruits to other traders without participating the Zespri network. So, one way to increase volumes of high quality kiwifruit could be done by recruiting the existing best growers and ensuring their products to Zespri in a long run. This pool of selected growers could also establish a positive example to other growers, who might shift their businesses to the Zespri supply programmes in the future.

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Appendix I

Questionnaire description

Farm characteristics

General information concerning the area of cultivation, the type of farm system (variety) and the size introduce the respondent.

Question 1: *In which area are you located?*
Question 1 is an open question where respondents can write the area of cultivation. Through this question we can identify their location and describe our sample.

Question 2: *How many hectares each variety (Zespri™Gold, Hayward, Hayward organic, other variety) did you have in the season 2011?*
We include this question to understand the differences of the cultivated area for each variety.

Question 3: *What is your total farm size in hectare?*
This is an open question which addresses the size of the farm. As discussed larger farms present different characteristics than the small one. This will lead to the identification of growers groups (large, medium, small plantations).

Question 4: *In what percentage from 2009 to 2011 your productivity has been reduced due to Psa (bacterial disease) (0-5%, 5-10%, 10-30%, 30-60%, 100 %)?*
We include the question about the decrease of productivity due to the *Psa* (bacterial disease), for the reason that infected kiwifruit vines tend to collapse with falling fruit production (Balestra, et al., 2009; Vanneste, et al., 2010). And question 4 addresses the decrease in productivity due to *Psa* outbreak, and shows which growers are the most affected. This question also quantifies the reduction in productivity of the previous season.

Question 5: *Are you in the healing phase at this moment (conversion to Hayward and/or other varieties)?*
In the last two years a lot of Zespri Gold growers have cut off their Zespri Gold vines, and it might be possible that they are in the transformation phase. From the existing rootstock growers can regrowth the plant of Hayward (green variety) and/or new varieties crafted in one/two years and return to sufficient productivity levels. During this healing phase the organization of the farm has somewhat change farm management and income. *Psa* has tremendously changed the operations of some farms. With this question we tackle the actual status of the orchard and whether or not is in the conversion phase.

Question 31: *Your farm is (family-owned, collective-owned or joint venture, other forms)?*
Question 31 addresses whether the farm is family or collectively owned, or if it is under other type of ownership. This will clarify the typology of farms investigated.

Farm performance

Farm performance and productivity is a direct measurement of the grower's skills. The growers capacity to "read the season" and technical factors of the kiwifruit production and manipulate vines accordingly is directly reflected by his/her orchard performance. Farm performance also reflects the growers' income achieved. The distinction in "high" and "low" outcome growers is linked with the

capacity to respect a delicate equilibrium between yield and quality, which depend on farm practices implemented.

Each crop is sold at diverse prices, so first we ask the typology of fruit produced for Zespri. Yield, fruit size and dry matter content can be considered as quality farm performance because, they indicate incentives received for quality. The index that combines all these indicators is the orchard gate returns (OGR). Through it we will be able to categorize growers in three stratified samples or categories: top-performing growers, average and low-performing. References used to formulate and reason these questions are: (Patterson & Currie, 2010), (Kilgour, et al., 2007), (Zespri, 2010), (Kiwiflier, 2011), (Cai & Wang, 2011), (Crisosto, et al., 2011) and (Fairweather, et al., 2007).

Question 6: *What was your yield per **hectare** (quintals/hectare) in 2011? (Please leave empty the categories that you did not produce)*

This close question measures what was the average yield of commercial fruit per hectare harvested in 2011. There are gap of 100 quintals differentiating the top performing growers from the low performing one. Furthermore, it addresses the quantity produced per each variety (Zespri™Gold, Hayward, Hayward organic, and other variety).

Question 7: *What was the average dry matter content when you harvest (< 15 %, 15-16 %, 16-17 %, 17-18 %, >19 %)?*

The measurement of the quality is achieved through the Dry Matter index (citation) and this question wants to assess it on the one hand and examine whether growers remember this index and how important is for them.

Question 8: *What was your average Orchard Gate Return per hectare (€/ha)?*

The orchard gate return (OGR) is the amount of money that the grower gets defined as the total amount of € paid back to the grower for one season per canopy hectare (€/ha/year). The OGR do not only measures the economical return of the growers but reflects multiple factors. Through it we will be able to categorize the pool of growers in three stratified samples or categories: top-performing growers, average and low-performing.

Farm management

This section begins with a series of questions concerning managerial approaches. This will enable us to have a more comprehensive assessment of how is composed the management team, how it operates and which actions have been taken to increase the productivity over the last few years. We formulate questions concerning the management team, whether it is a family business, how many people participate in the decision-making process, and which type of workforce do they use and whether they train their workers.

Question 2: *How many HECTARES of each variety (Zespri™Gold, Hayward, Hayward organic, other variety) did you have in the season 2011?*

Although this question has been described in the farm characteristics paragraph, it also shows the type of farming system which reflects diverse way of managing the plantations (Fairweather, et al., 2007).

Question 12: How many seasonal workers do you have?

This is an open question that describe the how the growers rely on the seasonal workforce.

Question 13: *How many permanent employees do you have? (Including temporary employees that work for more than three months)?*

This question reflects the importance and the presence of skilled employees in the farm.

Question 14: Farm management

- ✓ *I rely mostly on permanent (specialized) workers.*
- ✓ *The employees of my farm know the practices and procedures to manage kiwifruit vines.*
- ✓ *We have a good team to jointly resolve operational problems.*
- ✓ *I always take farm decisions in consultation with the employees.*

This series of questions illustrate the differences in the management organization of the farm. They investigate whether growers rely on the workforce, and in a team, and whether they include the employees in the decision-making process. The respondents can rank each question with five levels Likert scale (completely disagree, completely agree).

Question 15: *How often do you visit the Zespri Canopy website (never/once a year/every six months/once a month/once a week)?*
The Zespri canopy website is a tool to communicate new approaches, innovations, practices and general information about the kiwifruit industry. Here the intention is to measures which are the informatics skills of the farmer and how much do they consult the website to get updates concerning the cultivation practices.

Question 17: *To what extend you make use of external advisors/technicians/and third party information (cooperatives, Zespri, suppliers, etc.) to get knowledge and information for the following issues (1=never, 2=once a year, 3=every six months, 4=once a month, 5=once a week)?*

- ✓ *Managing the canopy*
- ✓ *Improve your pollination*
- ✓ *Managing the fertilization*
- ✓ *Using bio-stimulants*
- ✓ *Deal with Psa problems*
- ✓ *Improve your productivity in general*

Question 28: *What is your farming status (full-time or part-time)?*

This close question wants to address whether the grower dedicate most of his/her time to cultivate kiwifruit, or it is considered as an extra income (part-time) of the off-farm work. Reflections can be seen in the farm management in general.

Farm technical practices

Question 16: *What measure do you use the following technical practices? (1=never, 2=sometimes, 3=often, 4=more than often, 5=always)?*

In question 16 we addressed several aspects concerning technical practices used to produce optimal quality kiwifruit. The main focus is given on what practices each farmer is aware of and whether he knows how to apply them to improve quality and quantity. The question is divided in five groups of technical practices: canopy management, pollination, soil management, use of bio-stimulants and pest and diseases management.

Canopy management

- ✓ *Carefully select the canes during winter pruning*
- ✓ *Summer pruning*
- ✓ *Gel-pruning*

- ✓ *Tip-squeezing to contain vegetation*
- ✓ *Girdling to increase fruit size*
- ✓ *Fruit thinning*

Canopy management includes winter and spring pruning, wood selection practices and other crop practices aiming on having an appropriate ratio of leafs/fruits, better interception of light and to maximize the portioning of carbohydrate to promote fruit development (Patterson & Currie, 2010). By achieving these practices it is possible to maximize the number of fruit per m² of canopy, their quality in size and DM and therefore the orchard productivity (Patterson & Currie, 2010; Miller, et al., 2001; Thorp, et al., 2011).

Pollination

- ✓ *Use more pollination techniques (artificial)*

The effect that pollination has on fruit size has been proved by lots of researchers (Hopping & Jerram, 1979; Testolin, 1991; Costa, et al., 1993; Gonzales, et al., 1998; Goodwin, 2000; Costa, 2003; Patterson & Currie, 2010). The more attention and resources are dedicated to this delicate phase the more production can be achieved. Among the pollination methods wind, honeybees and artificial pollination systems have been developed and are commonly known among growers. Often Italian kiwifruit growers rely only on wind pollination, however, only through complementary pollination practices good size, marketable fruit can be produced (Asteggiano, et al., 2010). One question concern using more pollination techniques and the second wants to see how much importance growers give to the pollination in order to achieve commercial fruit size. The questions follow the same configuration (very important-not applicable).

Soil management

- ✓ *Analysing the soil and leaves*
- ✓ *Supplying the right fertilizers in each physiological phase*
- ✓ *Avoid water stress after fruit set*

Soil management includes fertilization and irrigation practices. The emphasis here is placed on how growers deal with these aspects throughout analysis and consultation with experts to correctly supply the right fertilizer in each phase. The importance of soil and leaves analysis to tailor the fertilization program to the single orchard needs was claimed by Sher (2008) and Pentreath (2011). Especially after fruit set Judd (1989) and Miller (1998) water stress can seriously affect fruit growth. The questions follow the same configuration (very important-not applicable).

Bio-stimulants

- ✓ *Use bio-stimulants to increase fruit size*

Lastly, we include in the survey the usage of bio-stimulants. These products increase fruit size and enhance growers' profitability (Patterson & Currie, 2010), however, when applied on orchard where inappropriate cultural techniques were used (scarce pollination, high crop load, inappropriate pruning) very negative effects can be seen in terms of dry matter and storability (Costa, et al., 2011). We want to test whether growers are aware of the complication of using bio-stimulators. The questions follow the same configuration (very important-not applicable).

Pest and diseases management

- ✓ *Monitoring the orchard from Psa symptoms in autumn, winter and spring*
- ✓ *Constantly remove the infected parts and burn them*
- ✓ *Apply bactericides according*

Pest and diseases management includes all the practices aimed on preserving the health conditions of vines and the quality of fruits. One question regards the monitor of the orchard from the *Psa*. And the second one refers to whether growers follow cooperative and Zespri procedures to prevent these diseases. The questions follow the same configuration (very important-not applicable).

Chain factors

Within this section we focus on the chain factors such as technical support, information transparency, innovations, and chain management factors. In each sub-section are reported the principal questions used.

Question 18: *Of which cooperative are you member (1=Apo Fruit, 2=Kiwi Pontino, 3=Intesa, 4=Spreafico, 5=Punto Frutta, Other=6)?*

To describe our sample and to define to which cooperative growers are associated we include this question in the questionnaire. Throughout this question we can also make comparison among cooperatives' services and support.

Question 19: *How long have you been associated to your cooperative?*

This question aims on understanding the time length of the relationship between cooperatives and growers, whether kiwifruit growers tent to have an independent mind-set *"selling their products to agents offering the best price"* (Hewett, 2003); or have a more integrated collaboration that last for several years in case of long-term relationships.

Question 20: *My cooperative informs me about ZESPRI guidelines concerning quality standards (1=never, 2=few times, 3=sometimes, 4=often, 5=always)?*

Question 21: *In which measure do you agree with the following statements?*

- ✓ *I am satisfied with the technical support provided by my cooperative*
- ✓ *I am satisfied with the technical support provided by Zespri*
- ✓ *I am satisfied with the advice provided by the suppliers of agricultural products*
- ✓ *I am satisfied with my cooperative's initiatives such as meetings, conferences, field days, trips, etc.*
- ✓ *I am satisfied with the Zespri initiatives such as field days, meetings, etc.*

External services are crucial factor in the day-to-day farming decisions (Moock, 1981). Any combination of inputs managed by the grower with more production-relevant education and technical services can produce more output (Kilpatrick, 2000). Technical advice is furnished by cooperatives, Zespri and suppliers of agricultural products. Starting with cooperatives services we attempted to cover the crucial aspects in line with the literature yielded. The question 16 and 19 reflect the respondent willingness to participate on the one hand, and the frequency of initiatives provided by cooperatives and Zespri on the other.

Question 23: *Provision of the information (1=completely disagree, 2=disagree, 3=neutral, 4=agree, 5=completely agree)?*

- ✓ *The market information provided by my cooperative are transparent*
- ✓ *I know who are my cooperative's buyers*
- ✓ *I know the price of the bulk market*
- ✓ *I am satisfied with the market information provided by Zespri*
- ✓ *I trust the technical and commercial information provided by my cooperative*
- ✓ *I trust the technical and commercial information provided by Zespri*

- ✓ *I am willing to collaborate more with my cooperative*
- ✓ *I am willing to collaborate more with Zespri*

The information transparency is defined as *"the degree of completeness of information, regarding their own business activities, provided by each company…"* (Vaccaro & Madsen, s.d.). According to Akkermans et al, (2004) *"the more supply chain partners work closely together, the more they will trust each other, and the more data they will dare to share"*. Therefore, we asked questions to assess the perception of the growers in perceiving the transparency, the trust to cooperatives and Zespri.

Question 25: *Who is the most important providers of these innovations (1=other growers, 2=suppliers of agricultural products, 3=cooperatives, 4=Zespri, 5=innovation sellers, 6=external expertise, 7=others)?*

Personal characteristics and opinions

Growers' characteristics such as age, farming status, farming experiences, education and personal opinions describe the respondents overall conditions and way of thinking. For instance one of our finding from the literature is that educational level does promote the adoption of innovations and better collaboration. Age as well determines influences other aspect of the farming system. These questions have been taken from other surveys, but in almost each growers survey we identify general questions such as this one.

Question 9: *Generally, how satisfied are you with your kiwifruit farming output at present (1=totally unsatisfied, 2=unsatisfied, 3=satisfied, 4=very satisfied, 5=completely satisfied).*

This is to understand what is the overall satisfaction rate of our sample.

Question 10: *How do you see the future prospects of your kiwifruit farm (1=very black, 2=black, 3= neither black nor bright, 4= bright, 5=very bright)?*

Question such as this one focus on investigate whether the actual feeling of our population is positive with regard to the future.

Question 11: *Which option best reflects where you might be in five years from now (1=land sold and retired, 2=land passed on to next generation, 3= farming but with significant income from off-farm work, 4= farming with most income from farm work, 5=farming kiwifruit as a main activity)?*

This nominal question intends to investigate what would be the future of their farm in the next five years.

Question 22: *Please rate the importance to you of each of the following statements (1=not important at all, 2=unimportant, 3=important, 4=very important, extremely important)?*

- ✓ *Share knowledge and information between growers and expertise, technicians, researchers etc.*
- ✓ *Visiting top-performing growers' orchard and provide evidences of the practices adopted*
- ✓ *Benchmark your performance with other growers to stimulate inter-farm competition*

Question 24: *How important are for you the following statements? Please, rate the importance to you of each of the following statements (1= completely disagree, 2=disagree, 3=neutral, 4=agree, 5=completely agree).*

- ✓ *Implementing innovations to enhance farm productivity*
- ✓ *Hire new members to the farm management team*
- ✓ *Apply new approaches to labour use*

- ✓ *Adopt new varieties*

The recognition and implementation of new technologies and farm management practices are crucial to improve the farm performance (Bella & Martin, 2009). The adoption rate of agricultural technologies depends on *"a range of personal, social, cultural and economic factors, as well as on the characteristics of the innovation itself"* (Pannell, et al., 2006; Howley, et al., 2012). Here we are interested in understanding growers concern towards innovations. Who are the innovation facilitators, and so on.

Question 26: *What is your AGE?*

Question 27: *What is your gender (1=Male, 2=Female)*

Question 29: *How many years have you been working in the kiwifruit farm?*

Question 30: *What is your education level (1=elementary school, 2=middle school 13 years old, 3=high school, 4= university)?*

Appendix II

This questionnaire is purely confidential and does not aim on addressing to you or anybody else responsibilities. The main objective is to understand the Italian kiwifruit industry and in particular by what measures the productivity of growers can be improved through better collaboration with chain partners such as Marketers and Cooperatives. This study belongs to a thesis project held by a master student of the University of Wageningen (Holland). It will take only 15 minutes. Please tick your answers in the boxes and where necessary write it. Thank you for your collaboration.

1. **In which area are you located?** ☐

2. **How many HECTARES of each variety did you have in the season 2011?**

Zespri™Gold	ha	☐
Hayward (green)	ha	☐
Hayward (organic)	ha	☐
Other?	ha	☐

3. **What is your total farm size in HECTARES?** ha ☐

4. **In what percentage from 2009 to 2011 your productivity has been reduced due to *Psa* (bacterial disease)?**

☐ 0-5% ☐ 5-10% ☐ 10-30% ☐ 30-60% ☐ 100 %

5. **At this moment are you in the healing phase (conversion to Hayward and/or other varieties)?**

☐ Yes ☐ No

6. **What was your yield per HECTARE (quintals/hectare) in 2011? (Please leave empty the categories that you did not produce)**

	<200 ql	200-300 ql	300-400 ql	400-500 ql	>500ql
Zespri™Gold	☐	☐	☐	☐	☐
Hayward	☐	☐	☐	☐	☐
Hayward (organic)	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

7. **What was the average dry matter (DM) content when you harvest (2011)?**

☐ < 15 % ☐ 15-16 % ☐ 16-17 % ☐ 17-18 % ☐ >19 %

8. **What was your average Orchard Gate Return per HECTARE in 2011?**

	Zespri™Gold	**Hayward**	**Hayward (organic)**
< 5.000 €/ha	☐	☐	☐
5.000-10.000 €/ha	☐	☐	☐
10.000–15.000 €/ha	☐	☐	☐
15.000 – 20.000 €/ha	☐	☐	☐
20.000 - 25.000€/ha	☐	☐	☐
25.000 - 30.000 €/ha	☐	☐	☐
30.000 - 40.000 €/ha	☐	☐	☐
>40.000 €/ha	☐	☐	☐

	Very unsatisfied	Unsatisfied	Satisfied	Very satisfied	Completely satisfied
9. **Generally, how satisfied are you with your kiwifruit farming output at present?**	☐	☐	☐	☐	☐

	Very black	Black	Neither black nor bright	Bright	Very bright
10. **Do you see the future prospects of your kiwifruit farm or orchard as:**	☐	☐	☐	☐	☐

11. Which option best reflects where you might be in five years from now?

☐ Land sold and retired
☐ Land passed on to next generation
☐ Still farming kiwifruit but with significant income from off-farm work
☐ Still farming with significant income from farm activities
☐ Still farming kiwifruit as main activity

12. How many seasonal workers do you have? Number of employees ☐

13. How many PERMANENT employees do you have?
Number of employees (including temporary workers for more than three months) Number of employees ☐

14. Farm management	Completely disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I rely mostly on permanent (specialized) workers	☐	☐	☐	☐	☐
The employees of my farm know the practices and procedures to manage kiwifruit vines	☐	☐	☐	☐	☐
We have a good team to jointly resolve operational problems	☐	☐	☐	☐	☐
I always take farm decisions in consultation with the employees	☐	☐	☐	☐	☐

	Never	Once a year	Every 6 months	Once a month	Once a week
15. How often do you visit the Zespri Canopy website	☐	☐	☐	☐	☐

Technical

16. Please rate how often do you use these practices

Canopy management	Never	Sometimes	Enough	More than Enough	Always
carefully select the canes during winter pruning	☐	☐	☐	☐	☐
summer pruning	☐	☐	☐	☐	☐
gel-pruning	☐	☐	☐	☐	☐
tip-squeezing to contain vegetation	☐	☐	☐	☐	☐
girdling to increase fruit size	☐	☐	☐	☐	☐
fruit thinning	☐	☐	☐	☐	☐
use more pollination techniques (artificial)	☐	☐	☐	☐	☐
Analysing the soil and leaves	☐	☐	☐	☐	☐
Supplying the right fertilizers in each physiological phase	☐	☐	☐	☐	☐
Avoid water stress after fruit set	☐	☐	☐	☐	☐
Use bio-stimulants to increase fruit size	☐	☐	☐	☐	☐
Monitoring the orchard from *Psa* symptoms	☐	☐	☐	☐	☐

Constantly remove the infected parts and burn them	□	□	□	□	□
Apply bactericides according to Zespri guidelines	□	□	□	□	□

17. To what extend you make use of external advisors/technicians/and third parties to get knowledge and information concerning the following issues:

	Never	Once a year	Every 6 months	Once a month	Once a week
Managing the canopy	☐	☐	☐	☐	☐
Improve your pollination effectiveness	☐	☐	☐	☐	☐
Managing the fertilization	☐	☐	☐	☐	☐
Using bio-stimulants	☐	☐	☐	☐	☐
Deal with *Psa* problems	☐	☐	☐	☐	☐
Improve your productivity in general	☐	☐	☐	☐	☐

18. To which cooperative are you member?

☐ Apo Fruit ☐ Kiwi Pontino ☐ Intesa ☐ Spreafico ☐ Punto Frutta Other

19. How long have you been associated to your cooperative? ☐

20. My cooperative informs me about ZESPRI guidelines concerning quality standards

☐never ☐ few times ☐ sometimes ☐ often ☐ always

21. In which measure do you agree with the following statements.

	Completely disagree	Disagree	Neutral	Agree	Strongly agree
I am satisfied with the technical support provided by my cooperative	☐	☐	☐	☐	☐
I am satisfied with the technical support provided by Zespri	☐	☐	☐	☐	☐
I am satisfied with the advice provided by the suppliers of agricultural products	☐	☐	☐	☐	☐
I am satisfied with my cooperative's initiatives such as meetings, conferences, field days, trips, etc.	☐	☐	☐	☐	☐
I am satisfied with the Zespri initiatives such as field days, meetings, etc.	☐	☐	☐	☐	☐

22. Please rate the importance to you of each of the following statements:

	Not important	Of little importance	Important	Very important	Extremely Important
Share knowledge and information between growers and expertise, technicians, researchers etc.	☐	☐	☐	☐	☐
Visiting top-performing growers' orchard and provide evidence of the practices adopted	☐	☐	☐	☐	☐
Benchmark your performance with other growers to stimulate inter-farm competition	☐	☐	☐	☐	☐

23. Provision of the information

	Completely disagree	Disagree	Neutral	Agree	Strongly agree
The market information provided by my cooperative are transparent	☐	☐	☐	☐	☐
I know who are my cooperative's buyers	☐	☐	☐	☐	☐
I know the price of the bulk market	☐	☐	☐	☐	☐
I am satisfied with the market information provided by Zespri	☐	☐	☐	☐	☐
I trust the technical and market information provided by my cooperative	☐	☐	☐	☐	☐
I trust the technical and market information provided by Zespri	☐	☐	☐	☐	☐
I am willing to collaborate more with my cooperative	☐	☐	☐	☐	☐
I am willing to collaborate more with Zespri	☐	☐	☐	☐	☐

Innovation

24. How important are for you the following statements? Please, rate the importance to you of each of the following statements:

	Completely disagree	Disagree	Neutral	Agree	Completely agree
Implementing innovations to enhance farm productivity	☐	☐	☐	☐	☐
Hire specialized workers to improve the farm management	☐	☐	☐	☐	☐
Apply new approaches to labour use	☐	☐	☐	☐	☐
Adopt new varieties	☐	☐	☐	☐	☐

25. Who is the most important providers of these innovations?

☐ other growers ☐ Suppliers of agricultural products ☐ Cooperatives ☐ Zespri

☐ Innovation sellers ☐ External expertise ☐ others

26. What is your AGE? ☐

27. What is your GENDER?

☐ Male ☐ Female

28. What is your farming status?

☐ Full time ☐ Part time with income from off-farm work

29. How many years have you been working in the kiwifruit farm? ☐

30. What is your education level?

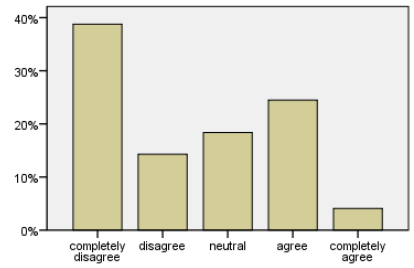
☐ Elementary school ☐ Middle school (till 13 years old) ☐ High school (till 19 years old) ☐ University

31. Your farm is:

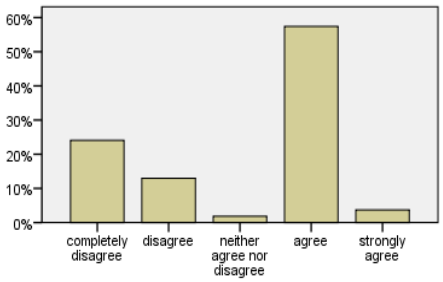
☐ Family-owned ☐ Collective-owned or joint venture ☐ Other forms

Appendix III

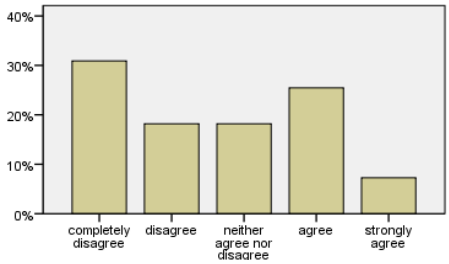
Descriptive statistics



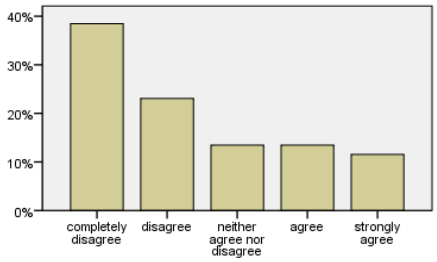
Question 14a: "I rely on permanent (specialized) employees".



Question 14b: "The employees of my farm know the practices and procedures to manage kiwifruit vines".



Question 14c: "We have a good team that jointly resolve operational problems. "



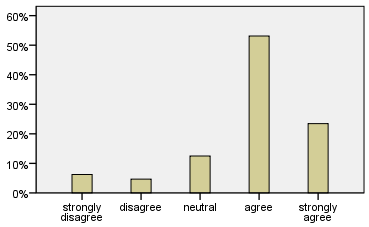
Question 14d: "I always take farm decision in consultation with employees".

		Carefully select the canes	I do summer pruning	I do gel pruning	I do tip-squeezing	I do girdling	I do flowers and fruit thinning	I use more pollination techniques (artificial)	I analyze soil and leaves
N	Valid	61	61	59	59	63	61	62	59
	Missing	13	13	15	15	11	13	12	15
Mean		4.66	3.39	1.46	1.73	1.24	4.73	3.72	3.31
Mode		5	5	1	1	1	5	5	4

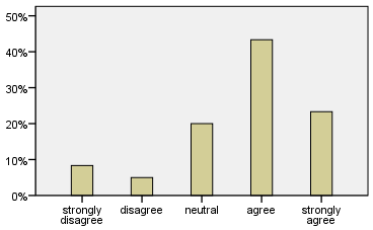
Question 16a: Mean, mode, valid and missing answer of farm practices questions.

		I supply the right fertilizers in each physiological phase	I avoid water stress after fruit set	I use bio stimulants to increase fruit size	I constantly monitor the orchard from *Psa* symptoms	I immediately remove the infected parts	I apply pesticides according to Zespri guidelines
N	Valid	63	63	62	60	61	62
	Missing	11	11	12	14	13	12
Mean		4.52	4.48	1.85	4.44	4.10	4.02
Mode		5	5	1	5	5	5

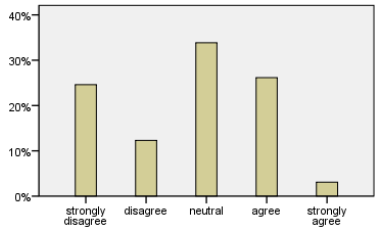
Question 16b: Mean, mode, valid and missing answer of farm practices questions.



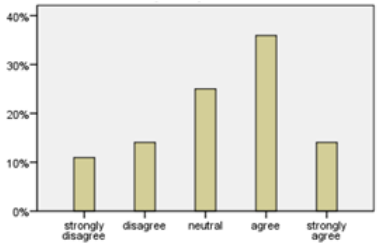
Question 21a: "I am satisfied with the technical support provided by my cooperative".



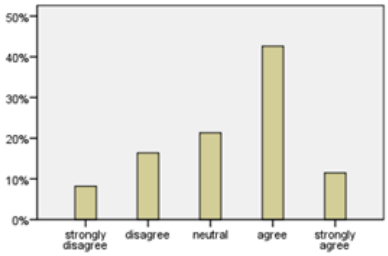
Question 21b: "I am satisfied with the technical support provided by Zespri".



Question 21c: "I am satisfied of the advice provided by the suppliers of agricultural products".



Question 21d: "I am satisfied with my cooperative's initiatives such as meetings, conference, firld days".



Question 21e: "I am satisfied with the Zespri's initiatives such as meetings, conference, firld days".

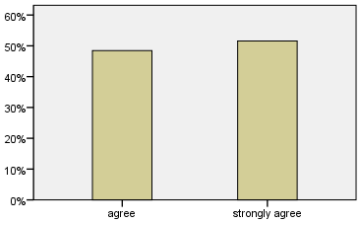


Figure 38: "implementing innovations to increase farm productivity".

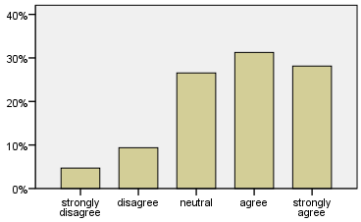


Figure 38: "hire specialized employees to improve farm productivity".

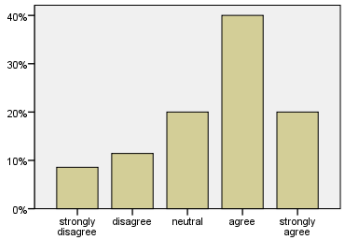


Figure 38: "apply new approaches to labour use".

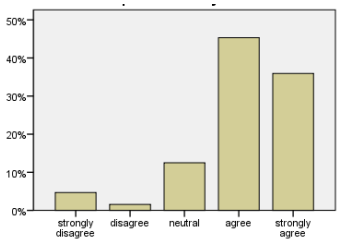


Figure 38: "adopt new varieties".

Appendix IV

Correlation analysis

Relationships 1: (6-1) Growers' productivity → Chain factors

Spearman's rho correlation		19) How long have you been associated to your cooperative?	20) My cooperative informs me about the Zespri guidelines concerning the quality standards?	21) In which measure do you agree with the following statements: I am satisfied with the technical support provided by my cooperative	I am satisfied with the technical support provided by Zespri	I am satisfied with the advice provided by the suppliers of agricultural products	I am satisfied with my cooperative's initiatives	I am satisfied with the Zespri's initiatives	23) Provision of the information: The market information provided by my cooperative are transparent	I know who are my cooperative's buyers	I know the price of the bulk market	I am satisfied with the market information provided by Zespri	I trust the technical and market information provided by my cooperative	I trust the technical and market information provided by Zespri
What was your **yield** of **Zespri Gold** per hectare in 2011?	*r*	.040	-.047	-.155	**-.586****	.105	.050	**-.603****	-.282	**-.391**	**-.372**	-.313	-.283	**-.379**
	Sig	.854	.824	.460	**.002**	.618	.812	**.001**	.171	**.053**	**.067**	.128	.170	**.062**
	N	24	25	25	25	25	25	25	25	25	25	25	25	25
What was your **yield** of **Hayward** per hectare in 2011?	*r*	-.088	**-.270**	-.198	-.051	.022	**-.336***	-.144	**-.467****	**-.421****	**-.264**	**-.278**	**-.359***	**-.361***
	Sig	.543	**.061**	.168	.734	.877	**.017**	.330	**.001**	**.003**	**.067**	**.062**	**.011**	**.013**
	N	50	49	50	47	50	50	48	49	49	49	46	49	47
What was the average **Dry Matter** at the harvest of 2011?	*r*	**.280**	.163	.001	-.230	-.028	.190	-.077	.082	-.150	.018	.081	.124	.003
	Sig	**.057**	.273	.992	.128	.849	.195	.613	.581	.309	.906	.595	.402	.985
	N	47	47	48	45	48	48	45	48	48	48	46	48	47
What was your **OGR** per hectare of **Zespri Gold** in 2011?	*r*	.179	.088	-.108	-.254	**.439***	.089	-.232	-.263	**-.355**	**-.343**	-.238	-.171	**-.330**
	Sig	.363	.654	.584	.193	**.019**	.652	.235	.177	**.064**	**.074**	.222	.385	**.087**
	N	28	28	28	28	28	28	28	28	28	28	28	28	28
What was your **OGR** per hectare of **Hayward** in 2011?	*r*	.017	-.215	-.201	.023	.029	-.223	.065	-.224	**-.305***	**-.349***	**-.397****	**-.453****	**-.459****
	Sig	.909	.143	.166	.879	.841	.124	.668	.121	**.033**	**.013**	**.006**	**.001**	**.001**
	N	48	48	49	45	49	49	46	49	49	50	46	49	47

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Relationships 2: (6-2) Growers' productivity → Growers' attitudes

Spearman's rho correlation		9) Generally, how satisfied are you with your actual production?	10) Do you see the future prospects of your farm as?	11) Which of the following options reflects where you might be in five years from now?	22) Please rate the importance to you of each of the following statements: Share knowledge and information between growers and expertise, technicians and researchers	22) Visiting top-performing growers' orchard and provide evidence of the practices adopted	22) Benchmark your performance with other growers to stimulate inter-farm competition	23) Provision of the information: I am willing to collaborate more with my cooperative	23) I am willing to collaborate more with Zespri	24) How important are for you the following statements? Implementing innovations to enhance farm productivity	Hire specialized workers to improve farm productivity	Apply new approaches to labour use	Adopt new variety	26) What is your age?	29) How many years have you been working in kiwifruit farm?	30) What is your education level?
What was your **yield** of **Zespri Gold** per hectare in 2011?	*r*	.225	.121	.012	**.361**	.272	.288	.132	.199	.260	.283	.361	**.551****	.251	-.126	-.069
	Sig	.249	.541	.951	**.076**	.188	.162	.528	.341	.219	.180	.306	**.005**	.226	.549	.738
	N	28	28	28	25	25	25	25	25	24	24	10	24	25	25	26
What was your **yield** of **Hayward** per hectare in 2011?	*r*	.150	.029	.118	-.072	-.001	.056	-.047	-.039	.049	.004	.149	.080	.130	.077	-.123
	Sig	.277	.837	.394	.612	.996	.691	.748	.794	.743	.976	.488	.591	.369	.593	.390
	N	54	54	54	52	52	52	49	47	48	48	24	48	50	50	51
What was the average **Dry Matter** at the harvest of 2011?	*r*	-.212	.024	.016	**.344***	.171	.039	.052	.138	.195	-.018	.019	**.239**	.163	.226	-.021
	Sig	.131	.864	.912	**.015**	.241	.790	.724	.356	.184	.905	.931	**.101**	.268	.123	.886
	N	52	52	52	49	49	49	48	47	48	48	24	48	48	48	49
What was your **OGR** per hectare of **Zespri Gold** in 2011?	*r*	**.407***	**.453***	.204	.101	.196	.023	-.067	-.106	.277	**.323**	.478	**.512****	**.331**	.010	-.027
	Sig	**.026**	**.012**	.280	.610	.317	.909	.734	.590	.163	**.101**	.193	**.006**	**.085**	.960	.890
	N	30	30	30	28	28	28	28	28	27	27	9	27	28	28	29
What was your **OGR** per hectare of **Hayward** in 2011?	*r*	.163	-.118	.076	-.024	.093	-.010	.087	.081	.023	.008	.191	.043	-.066	.090	-.181
	Sig	.243	.400	.586	.865	.518	.947	.552	.589	.877	.955	.331	.771	.651	.533	.204
	N	53	53	53	51	51	51	49	47	48	48	28	48	50	50	51

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Relationship 3: (6-3) Growers' productivity → Farm characteristics

Spearman's rho correlation		2) How many hectares of Zespri Gold did you have in 2011?	2 How many hectares of Hayward did you have in 2011?	3 What is your total farm size (ha)?	4 In what percentage from 2009 to 2011 your productivity has been reduced due to *Psa*?	5 At this moment are you in the healing phase (conversion to other varieties)?
What was your **yield** of **Zespri Gold** per hectare in 2011?	*r*	.263	.143	-.032	-.077	.174
	Sig	.194	.535	.870	.702	.377
	N	26	21	28	27	28
What was your **yield** of **Hayward** per hectare in 2011?	*r*	.307	.070	.031	-.148	**-.284***
	Sig	.135	.626	.826	.294	**.040**
	N	25	51	54	52	53
What was the average **Dry Matter** at the harvest of 2011?	*r*	.019	.151	.066	.107	-.081
	Sig	.918	.352	.642	.453	.573
	N	33	40	52	51	51
What was your **OGR** per hectare of **Zespri Gold** in 2011?	*r*	.197	.327	-.083	-.081	-.064
	Sig	.297	.160	.662	.676	.738
	N	30	20	30	29	30
What was your **OGR** per hectare of **Hayward** in 2011?	*r*	.218	.213	.083	-.058	**-.309***
	Sig	.330	.133	.556	.684	**.026**
	N	22	51	53	51	52

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Relationship 4: (6-4) Growers' productivity → Farm management

Spearman's rho correlation		13)	14) Farm management				15)	17) To what extend you make use of external advisors and to get knowledge and information concerning the following issues					
		How many permanent employees do you have?	I rely mostly on permanent (specialized) employees	The employees of my farm know the practices and procedures to manage kiwifruit vines	we have a good team that jointly resolve operational problems	I always take decision in consultation with the employees	How often do you visit the Zespri Canopy website	Managing the canopy	Improve pollination	Fertilization management	Apply bio stimulants	Deal with *Psa*	Improve your productivity
What was your **yield** of **Zespri Gold** per hectare in 2011?	*r*	-,486	,173	,451	,261	,417	,249	-,009	,093	,243	.423*	-,138	-,177
	Sig	,078	,522	,060	,267	,085	,230	,964	,651	,241	,031	,501	,396
	N	14	16	18	20	18	25	26	26	25	26	26	25
What was your **yield** of **Hayward** per hectare in 2011?	*r*	-,032	-,276	-.461**	-,221	-.324*	,067	-.291*	-.423**	-,203	,071	-,053	-.350*
	Sig	,870	,084	,002	,145	,036	,684	,050	,003	,180	,637	,725	,017
	N	29	40	44	45	42	39	46	46	45	47	46	46
What was the average **Dry Matter** at the harvest of 2011?	*r*	,033	,177	.333*	,223	,303	-,057	,171	.297*	,073	,110	,229	,062
	Sig	,867	,310	,041	,167	,068	,717	,245	,040	,628	,453	,117	,673
	N	28	35	38	40	37	43	48	48	47	49	48	48
What was your **OGR** per hectare of **Zespri Gold** in 2011?	*r*	-,149	-,014	,160	-,060	,154	,202	,152	-,126	,120	.600**	-,045	-,149
	Sig	,596	,957	,500	,790	,517	,292	,431	,514	,544	,001	,816	,448
	N	15	18	20	22	20	29	29	29	28	29	29	28
What was your **OGR** per hectare of **Hayward** in 2011?	*r*	-,100	-,238	-.335*	-,254	-,169	-,217	-.298*	-.294*	-,189	,179	-,046	-,158
	Sig	,586	,139	,026	,096	,290	,211	,047	,050	,218	,235	,762	,299
	N	32	40	44	44	41	35	45	45	44	46	45	45

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Relationship 5: (6-5) Growers' productivity → Farm technical practices

Spearman's rho correlation		16) Please rate how often do you use these practices													
		Carefully select the canes	I do summer pruning	I do gel pruning	I do tip-squeezing	I do girdling	I do flowers and fruit thinning	I use more pollination techniques (artificial)	I analyse soil and leaves	I supply the right fertilizers in each physiological phase	I avoid water stress after fruit set	I use bio stimulants to increase fruit size	I constantly monitor the orchard from *Psa* symptoms	I immediately remove the infected parts	I apply pesticides according to Zespri guidelines
What was your **yield** of **Zespri Gold** per hectare in 2011?	*r*	,063	-,087	**.511****	-,069	-,026	,159	,128	,197	,005	-,068	**.444***	,041	,111	-,108
	Sig	,764	,671	**,009**	,744	,904	,437	,553	,345	,979	,740	**,023**	,841	,599	,601
	N	25	26	25	25	24	26	24	25	26	26	26	26	25	26
What was your **yield** of **Hayward** per hectare in 2011?	*r*	-,069	-,085	,009	-,172	-,136	**-,258**	,163	,130	,054	,120	**,285**	-,023	-,153	-,180
	Sig	,647	,576	,951	,259	,375	**,077**	,274	,380	,717	,417	**,052**	,881	,315	,232
	N	47	46	45	45	45	48	47	48	48	48	47	47	45	46
What was the average **Dry Matter** at the harvest of 2011?	*r*	,061	,139	**.425****	,083	,033	,023	-,095	,056	-,099	-,147	-,105	,241	**,263**	**.289***
	Sig	,685	,350	**,003**	,585	,827	,873	,527	,707	,498	,312	,473	,095	**,074**	**,047**
	N	47	47	46	46	45	49	47	48	49	49	49	49	47	48
What was your **OGR** per hectare of **Zespri Gold** in 2011?	*r*	,090	,071	**,365**	-,076	-,017	,085	,137	,107	,099	,298	**.656****	,130	,083	-,286
	Sig	,648	,716	**,056**	,695	,934	,659	,495	,588	,608	,116	**,000**	,502	,676	,132
	N	28	29	28	29	27	29	27	28	29	29	29	29	28	29
What was your **OGR** per hectare of **Hayward** in 2011?	*r*	**,264**	,035	,095	-,137	-,239	,176	**.325***	,070	,138	**.342***	**.406****	,067	-,103	-,197
	Sig	**,076**	,817	,534	,381	,118	,238	**,027**	,639	,356	**,018**	**,005**	,657	,506	,195
	N	46	45	45	43	44	47	46	,197	,005	-,068	**.444***	,041	,111	-,108

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Relationships 6: (1-4) Chain factors → Farm management

Spearman's rho correlation		13) How many permanent employees do you have?	14) Farm management: I rely mostly on permanent (specialized) employees	14) Farm management: The employees of my farm know the practices and procedures to manage kiwifruit vines	14) Farm management: We have a good team that jointly resolve operational problems	14) Farm management: I always take decision in consultation with the employees	15) How often do you visit the Zespri Canopy website	17) To what extend you make use of external advisors and to get knowledge and information concerning the following issues: Managing the canopy	Improve pollination	Fertilization management	Apply bio stimulants	Deal with *Psa*	Improve your productivity
19 How long have you been associated to your cooperative?	*r*	.433**	-,066	,183	,250	,071	-,143	,167	-,043	,002	,138	,161	,047
	Sig	,007	,658	,199	,077	,629	,350	,210	,749	,988	,300	,228	,728
	N	38	47	51	51	49	45	58	58	57	58	58	57
20 My cooperative informs me about the Zespri guidelines concerning the quality standards?	*r*	,150	.324*	,241	.328*	,202	,055	,093	-,027	.308*	-.275*	.347**	,194
	Sig	,377	,028	,091	,020	,169	,718	,486	,840	,020	,037	,008	,148
	N	37	46	50	50	48	46	58	58	57	58	58	57
21 I am satisfied with the technical support provided by my cooperative	*r*	,131	,266	.295*	.291*	.317*	,159	,168	,166	,228	-.267*	,219	.321*
	Sig	,434	,071	,036	,038	,027	,292	,202	,209	,085	,041	,096	,014
	N	38	47	51	51	49	46	59	59	58	59	59	58
21 I am satisfied with the technical support provided by Zespri	*r*	-,169	-,102	-,055	-,055	,046	,079	,030	-,103	,080	-.291*	,215	,167
	Sig	,341	,514	,710	,713	,761	,600	,830	,456	,564	,031	,114	,228
	N	34	43	48	48	46	47	55	55	54	55	55	54
21 I am satisfied with the advice provided by the suppliers of agricultural products	*r*	,103	,150	,212	.313*	,160	-,018	.311*	,151	,247	,144	-,012	,245
	Sig	,531	,308	,132	,024	,266	,908	,016	,249	,059	,273	,928	,062
	N	39	48	52	52	50	46	60	60	59	60	60	59
21 I am satisfied with my cooperative's initiatives	*r*	.326*	.312*	,210	,208	,076	-,040	,221	,153	.359**	,084	.354**	.308*
	Sig	,046	,032	,140	,142	,602	,790	,093	,249	,006	,529	,006	,019
	N	38	47	51	51	49	46	59	59	58	59	59	58
21 I am satisfied with the Zespri's initiatives	*r*	,101	,154	-,056	-,011	-,054	-,109	,229	,028	,244	-,130	.388**	.310*
	Sig	,568	,325	,706	,940	,723	,464	,093	,841	,075	,343	,003	,023
	N	34	43	48	48	46	47	55	55	54	55	55	54
23 I know who are my cooperative's buyers	*r*	,178	,129	,166	,137	,107	,246	-,024	,020	,134	-.309*	.280*	.268*
	Sig	,278	,387	,249	,339	,465	,103	,858	,884	,319	,018	,033	,044
	N	39	47	50	51	49	45	58	58	57	58	58	57
23 I know the price of the bulk market	*r*	.354*	,136	.344*	.368**	,221	.447**	,145	,209	,172	-,222	.292*	.404**
	Sig	,027	,367	,016	,008	,131	,002	,283	,119	,206	,094	,027	,002
	N	39	46	49	51	48	45	57	57	56	58	57	57
23 I am satisfied with the market information provided by Zespri	*r*	,150	,040	,111	,157	,088	.336*	,216	,066	,080	-.276*	.371**	,262
	Sig	,382	,799	,463	,286	,563	,024	,116	,633	,571	,041	,006	,056
	N	36	43	46	48	45	45	54	54	53	55	54	54
23 I trust the technical and market information provided by my cooperative	*r*	,035	,176	.287*	,242	,132	.304*	,041	,078	.301*	-,227	.412**	.310*
	Sig	,831	,236	,043	,087	,366	,042	,760	,559	,023	,087	,001	,019
	N	39	47	50	51	49	45	58	58	57	58	58	57
23 I trust the technical and market information provided by Zespri	*r*	-,158	,053	,139	,131	,015	,256	,001	-,002	,173	-.323*	.354**	,195
	Sig.	,351	,733	,350	,370	,919	,085	,994	,988	,210	,015	,008	,154
	N	37	44	47	49	46	46	55	55	54	56	55	55

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Relationship 7: (1-5) Chain factors → Farm technical practices

Spearman's rho correlation		16) Please rate how often do you use these practices													
		Carefully select the canes	I do summer pruning	I do gel pruning	I do tip-squeezing	I do girdling	I do flowers and fruit thinning	I use more pollination techniques (artificial)	I analyse soil and leaves	I supply the right fertilizers in each physiological phase	I avoid water stress after fruit set	I use bio stimulants to increase fruit size	I constantly monitor the orchard from *Psa* symptoms	I immediately remove the infected parts	I apply pesticides according to Zespri guidelines
19 How long have you been associated to your cooperative?	*r*	,005	,035	,070	,097	,170	,199	-,047	-,119	-,089	-,098	.299*	,141	-,109	-,073
	Sig	,972	,797	,614	,472	,211	,135	,731	,380	,491	,450	,019	,277	,411	,580
	N	56	57	55	57	56	58	56	57	62	62	61	61	59	60
20 My cooperative informs me about the Zespri guidelines quality standards?	*r*	,253	,204	-,008	,038	,234	.370**	,100	,190	,035	-,171	,135	,201	,182	.272*
	Sig	,060	,128	,953	,781	,082	,004	,465	,156	,795	,199	,311	,130	,174	,039
	N	56	57	55	56	56	58	56	57	58	58	58	58	57	58
21 I am satisfied with the technical support provided by my cooperative	*r*	-,077	,104	-,183	,063	,101	,072	-,112	-,026	.349**	.327*	-.316*	,221	.287*	.348**
	Sig	,567	,437	,177	,642	,453	,590	,408	,846	,007	,012	,016	,096	,030	,007
	N	57	58	56	57	57	59	57	58	58	58	58	58	57	58
21 I am satisfied with the technical support provided by Zespri	*r*	,062	,173	-.453**	-,172	-,094	,098	-,045	-,006	,074	,111	-.364**	-,038	,015	.269*
	Sig	,657	,207	,001	,217	,499	,474	,746	,966	,577	,404	,005	,773	,913	,039
	N	54	55	53	53	54	56	54	55	59	59	59	59	58	59
21 I am satisfied with the advice provided by the suppliers	*r*	-,009	,041	-,131	,027	-,016	-,170	-,042	-,042	,110	.310*	-.308*	-,109	,056	,102
	Sig	,947	,758	,331	,838	,904	,194	,754	,751	,420	,020	,022	,429	,690	,460
	N	58	59	57	58	58	60	58	59	56	56	55	55	54	55
21 I am satisfied with my cooperative's initiatives	*r*	,038	,052	,163	,189	,197	,136	,098	-,093	-,048	,095	,200	-,016	,091	-,192
	Sig	,776	,697	,230	,159	,141	,304	,468	,490	,714	,471	,126	,903	,491	,141
	N	57	58	56	57	57	59	57	58	60	60	60	60	59	60
21 I am satisfied with the Zespri's initiatives	*r*	,132	,250	-,125	-,080	-,022	.356**	,204	,089	,170	,103	-,129	,083	,098	.377**
	Sig	,342	,066	,372	,568	,877	,007	,139	,518	,199	,439	,331	,532	,462	,003
	N	54	55	53	53	54	56	54	55	59	59	59	59	58	59
23 I know who are my cooperative's buyers	*r*	-,078	,033	-,147	,136	.294*	,115	-,022	-,112	.337*	.407**	,012	,227	,115	.298*
	Sig	,569	,809	,285	,316	,028	,391	,873	,408	,011	,002	,929	,095	,406	,027
	N	56	57	55	56	56	58	56	57	56	56	55	55	54	55
23 I know the price of the bulk market	*r*	-,082	,085	-,126	,170	,210	-,023	-,064	-,121	-,117	-,092	-,239	,218	,095	,149
	Sig	,550	,534	,364	,215	,124	,863	,639	,369	-,089	-,098	.299*	,141	-,109	-,073
	N	56	56	54	55	55	58	56	57	,491	,450	,019	,277	,411	,580
23 I am satisfied with the market information provided by Zespri	*r*	-,022	,159	-,021	,099	,145	,088	-,081	-,103	62	62	61	61	59	60
	Sig	,878	,256	,884	,486	,306	,523	,565	,460	,035	-,171	,135	,201	,182	.272*
	N	53	53	51	52	52	55	53	54	,795	,199	,311	,130	,174	,039
23 I trust the technical and market information provided by my cooperative	*r*	-,162	-,057	-,085	,071	,244	,093	-,033	-,025	58	58	58	58	57	58
	Si	,233	,676	,538	,601	,070	,490	,811	,851	.349**	.327*	-.316*	,221	.287*	.348**
	N	56	57	55	56	56	58	56	57	,007	,012	,016	,096	,030	,007
23 I trust the technical and market information provided by Zespri	*r*	-,081	-,118	-,248	-,086	,106	,059	-,039	-,038	58	58	58	58	57	58
	Sig	,558	,394	,076	,542	,451	,666	,779	,785	,074	,111	-.364**	-,038	,015	.269*
	N	54	54	52	53	53	56	54	55	,577	,404	,005	,773	,913	,039

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Relationship 8: (2-4) Growers' attitudes → Farm management

Spearman's rho correlation		13)	14) Farm management				15)	17) To what extend you make use of external advisors and to get knowledge and information concerning the following issues					
		How many permanent employees do you have?	I rely mostly on permanent (specialized) employees	The employees of my farm know the practices and procedures to manage kiwifruit vines	We have a good team that jointly resolve operational problems	I always take decision in consultation with the employees	How often do you visit the Zespri Canopy website	Managing the canopy	Improve pollination	Fertilization management	Apply bio stimulants	Deal with *Psa*	Improve your productivity
9 Generally, how satisfied are you with your actual production?	*r*	-,115	-,013	-,051	,006	,019	-,075	-,062	-,248	-,029	-,088	-,111	**-,219**
	Sig	,475	,927	,713	,966	,895	,608	,633	,054	,825	,496	,393	**,090**
	N	41	49	54	55	52	49	61	61	60	62	61	61
10 Do you see the future prospects of your farm as?	*r*	,108	,141	,120	,075	,094	,190	**.320***	,206	**.356****	,151	**,225**	,179
	Sig	,500	,334	,387	,588	,506	,191	**,012**	,112	**,005**	,242	**,081**	,168
	N	41	49	54	55	52	49	61	61	60	62	61	61
22 Share knowledge and information between growers and expertise, technicians and researchers	*r*	,190	,085	**.306***	**,243**	**.334***	**,258**	,173	**.275***	**.276***	**.258***	**.382****	**.294***
	Sig	,240	,567	**,026**	**,076**	**,016**	**,077**	,182	**,032**	**,032**	**,043**	**,002**	**,021**
	N	40	48	53	54	51	48	61	61	60	62	61	61
22 Visiting top-performing growers' orchard and provide evidence of the practices adopted	*r*	,214	,094	,209	,218	**.329***	,119	-,002	**.310***	,052	-,029	**.301***	**,225**
	Sig	,184	,527	,132	,113	**,019**	,419	,990	**,016**	,694	,825	**,019**	**,083**
	N	40	48	53	54	51	48	60	60	59	61	60	60
22 Benchmark your performance with other growers to stimulate inter-farm competition	*r*	,181	**,245**	,142	,207	**,234**	-,016	,164	**.310***	,160	,055	,154	**.315***
	Sig	,263	**,094**	,309	,134	**,098**	,914	,211	**,016**	,225	,671	,240	**,014**
	N	40	48	53	54	51	48	60	60	59	61	60	60
23 I am willing to collaborate more with my cooperative	*r*	,173	,184	,187	,066	**.288***	,208	-,007	,184	-,016	,103	,065	,174
	Sig	,294	,217	,193	,646	**,045**	,171	,959	,160	,906	,428	,620	,185
	N	39	47	50	51	49	45	60	60	59	61	60	60
23 I am willing to collaborate more with Zespri	*r*	,046	,192	**.335***	,199	**.491****	,288	,076	**,224**	,149	,095	**.338****	**,259**
	Sig	,789	,211	**,022**	,170	**,001**	,052	,573	**,091**	,268	,478	**,010**	**,051**
	N	37	44	47	49	46	46	58	58	57	58	58	57
24 Hire specialized workers to improve farm productivity	*r*	,093	**.430****	**,233**	,206	**.471****	,155	,098	**.295***	,147	-,049	,219	**.298***
	Sig	,575	**,002**	**,097**	,136	**,000**	,304	,475	**,029**	,288	,720	,108	**,027**
	N	39	48	52	54	51	46	55	55	54	56	55	55
24 Apply new approaches to labour use	*r*	,195	**,344**	**,325**	**.371***	**.429***	,305	**,237**	,185	**.265***	-,050	,078	,143
	Sig	,339	**,058**	**,074**	**,040**	**,014**	,205	**,074**	,165	**,046**	,705	,561	,285
	N	26	31	31	31	32	19	58	58	57	59	58	58
24 Adopt new variety	*r*	,264	,170	**,233**	**.290***	**,267**	,135	**,344**	,156	,235	,077	-,062	,285
	Sig	,105	,248	**,097**	**,034**	**,058**	,372	**,054**	,393	,196	,677	,737	,114
	N	39	48	52	54	51	46	32	32	32	32	32	32
26 What is your age?	*r*	-,005	**-,264**	-,202	-,122	**-.353***	-,058	,015	,017	,152	-,128	,242	,208
	Sig	,973	**,070**	,151	,378	**,011**	,703	,911	,898	,260	,333	,068	,118
	N	41	48	52	54	51	46	58	58	57	59	58	58
29 How many years have you been working in kiwifruit farm?	*r*	,137	**-,255**	-,140	,040	**-.325***	-,107	,041	-,069	-,036	,155	-,106	-,212
	Sig	,394	**,080**	,323	,775	**,020**	,481	,759	,607	,791	,242	,430	,111
	N	41	48	52	54	51	46	58	58	57	59	58	58
30 What is your education level?	*r*	**.444****	**.320***	**.398****	,199	**.373****	,162	-,031	,189	,116	-,036	,151	,194
	Sig	**,004**	**,025**	**,003**	,146	**,006**	,275	,810	,144	,379	,779	,244	,135
	N	41	49	53	55	52	47	61	61	60	62	61	61

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Relationship 9: (2-5) Personal characteristics and opinions → Farm technical practices

Spearman's rho correlation		16) Please rate how often do you use these practices												
		Carefully select the canes	I do summer pruning	I do gel pruning	I do tip-squeezing	I do girdling	I do flowers and fruit thinning	I use more pollination techniques (artificial)	I analyse soil and leaves	I supply the right fertilizers in each physiological phase	I avoid water stress after fruit set	I use bio stimulants to increase fruit size	I constantly monitor the orchard from *Psa* symptoms	I immediately remove the infected parts
9 Generally, how satisfied are you with your actual production?	*r*	,038	-,085	**-.262***	,069	,105	-,093	-,001	,143	**.347****	**,241**	**,228**	-,023	**-,240**
	Sig	,769	,522	**,045**	,604	,412	,474	,996	,262	**,005**	**,059**	**,074**	,861	**,063**
	N	61	59	59	59	63	61	62	63	63	62	62	60	61
10 Do you see the future prospects of your farm as?	*r*	,003	,104	,118	,148	,072	**,227**	,178	,129	,161	,116	**.336****	**.300***	,106
	Sig	,984	,432	,375	,262	,572	**,079**	,167	,313	,207	,369	**,008**	**,020**	,416
	N	61	59	59	59	63	61	62	63	63	62	62	60	61
22 Share knowledge and information between growers and technicians, researchers, etc.	*r*	**,248**	**.317***	**.312***	,165	,149	,209	,186	,045	-,086	-,086	**.257***	**,238**	**,221**
	Sig	**,056**	**,015**	**,017**	,213	,247	,108	,151	,729	,507	,508	**,045**	**,070**	**,090**
	N	60	58	58	59	62	60	61	62	62	61	61	59	60
22 Visiting top-performing growers' orchard and provide evidence of the practices adopted	*r*	**,229**	,169	**,237**	,130	,125	,137	,170	-,024	-,036	,014	,156	,165	,108
	Sig	**,078**	,205	**,073**	,326	,333	,296	,189	,854	,781	,913	,231	,211	,412
	N	60	58	58	59	62	60	61	62	62	61	61	59	60
22 Benchmark your performance with other growers to stimulate inter-farm competition	*r*	,159	**.307***	,173	**,240**	,072	,106	,083	,059	-,059	,039	,075	,021	,082
	Sig	,226	**,019**	,195	**,067**	,579	,422	,523	,646	,647	,766	,566	,875	,535
	N	60	58	58	59	62	60	61	62	62	61	61	59	60
23 I am willing to collaborate more with my cooperative	*r*	**,229**	**.268***	**,243**	,123	**,239**	**.321***	,194	**.325***	**.270***	,015	,199	,195	**.292***
	Sig	**,087**	**,048**	**,072**	,365	**,070**	**,016**	,149	**,013**	**,040**	,913	,134	,142	**,026**
	N	57	55	56	56	58	56	57	58	58	58	58	58	58
23 I am willing to collaborate more with Zespri	*r*	**,256**	**,261**	,207	,063	,105	**,254**	,206	,188	,068	-,093	,165	**,224**	,174
	Sig	**,062**	**,062**	,137	,655	,443	**,064**	,131	,166	,619	,494	,224	**,100**	,204
	N	54	52	53	53	56	54	55	56	56	56	56	55	55
24 Hire specialized workers to improve farm productivity	*r*	,028	**.274***	,192	-,016	**,249**	,061	**.345****	**.334****	,167	-,024	,020	,025	,203
	Sig	,837	**,041**	,156	,908	**,055**	,647	**,007**	**,009**	,203	,858	,881	,851	,126
	N	58	56	56	57	60	58	59	60	60	59	59	58	58
24 Apply new approaches to labour use	*r*	,140	,263	,138	-,131	**,299**	-,165	,202	,173	,061	-,008	-,073	-,089	,082
	Sig	,446	,152	,458	,483	**,096**	,375	,276	,342	,738	,967	,690	,628	,655
	N	32	31	31	31	32	31	31	32	32	32	32	32	32
24 Adopt new variety	*r*	**.270***	**.366****	,218	,204	,076	,174	**.270***	,193	,137	,016	**.287***	,087	,161
	Sig	**,040**	**,006**	,107	,129	,563	,191	**,039**	,139	,295	,905	**,028**	,517	,228
	N	58	56	56	57	60	58	59	60	60	59	59	58	58
26 What is your age?	*r*	**-.281***	-,031	-,011	,123	**-.284***	-,136	,112	-,160	-,155	,149	-,196	-,091	**-.321***
	Sig	**,033**	,820	,936	,360	**,028**	,308	,398	,221	,237	,259	,136	,499	**,014**
	N	58	56	56	57	60	58	59	60	60	59	59	58	58
29 How many years have you been working in kiwifruit farm?	*r*	-,040	-,222	-,122	,002	,019	-,075	-,015	**-,221**	-,119	,190	-,148	-,090	-,076
	Sig	,768	,101	,372	,990	,886	,573	,910	**,090**	,364	,150	,264	,500	,573
	N	58	56	56	57	60	58	59	60	60	59	59	58	58
30 What is your education level?	*r*	,213	,144	,157	,153	-,040	-,058	-,210	-,017	-,207	,007	-,091	-,029	-,039
	Sig	,105	,284	,245	,257	,759	,664	,106	,896	,109	,956	,490	,827	,768
	N	59	57	57	57	61	59	60	61	61	60	60	59	59

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Relationship 10: (3-4) Farm characteristics → Farm management

Spearman's rho correlation		13 How many permanent employees do you have?	14 I rely mostly on permanent (specialized) employees	14 The employees of my farm know the practices and procedures to manage kiwifruit vines	14 we have a good team that jointly resolve operational problems	14 I always take decision in consultation with the employees	15 How often do you visit the Zespri Canopy website	17 managing the canopy	17 improve pollination	17 fertilization management	17 apply bio stimulants	17 deal with *Psa*	17 improve your productivity
2 How many hectares of Zespri Gold did you have in 2011?	*r*	.101	-.068	-.247	.099	.172	.077	.043	.156	.100	.197	.078	-.167
	Sig	.354	.388	.122	.319	.216	.336	.408	.197	.297	.140	.335	.185
	N	16	20	24	25	23	33	32	32	31	32	32	31
2 How many hectares of Hayward did you have in 2011?	*r*	**.697****	.131	.176	.176	**.277***	.123	.248*	.216	**.353****	**.335****	.158	**.343****
	Sig	**.000**	.206	.124	.121	**.036**	.228	.047	.072	**.008**	**.010**	.144	**.009**
	N	32	41	45	46	43	39	47	47	46	48	47	47
3 What is your total farm size (ha)?	*r*	**.700****	.161	**.327****	**.462****	**.417****	.216	**.339****	.114	**.321****	.160	.117	**.341****
	Sig	**.000**	.135	**.008**	**.000**	**.001**	.066	**.004**	.191	**.006**	.107	.185	**.004**
	N	41	49	54	55	52	50	61	61	60	62	61	61
4 In what percentage from 2009 to 2011 your productivity has been reduced due to *Psa*?	*r*	**.309***	**.349****	.108	.022	.060	.112	.093	**.232***	.112	.187	.124	**.284***
	Sig	**.025**	**.007**	.224	.438	.339	.224	.239	**.037**	.199	.075	.172	**.014**
	N	41	49	52	54	51	48	60	60	59	61	60	60
5 At this moment are you in the healing phase (conversion to other varieties)?	*r*	**-.373****	-.174	.012	.073	-.054	.053	.016	-.020	-.092	-.097	**-.326****	**-.220***
	Sig	**.008**	.116	.465	.297	.353	.358	.452	.439	.244	.229	**.005**	**.045**
	N	41	49	54	55	52	49	60	60	59	61	60	60

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Relationship 11: (4-5) Farm management → Farm technical practices

Spearman's rho correlation		16) Please rate how often do you use these practices												
		I do summer pruning	I do gel pruning	I do tip-squeezing	I do girdling	I do flowers and fruit thinning	I use more pollination techniques (artificial)	I analyze soil and leaves	I supply the right fertilizers in each physiological phase	I avoid water stress after fruit set	I use bio stimulants to increase fruit size	I constantly monitor the orchard from *Psa* symptoms	I immediately remove the infected parts	I apply pesticides according to Zespri guidelines
13 How many permanent employees do you have?	*r*	.261	.039	.266	**.486****	-.137	-.143	**-.315***	-.205	-.182	-.178	-.168	-.116	.207
	Sig	.062	.413	.058	**.002**	.210	.203	**.031**	.112	.141	.147	.161	.250	.113
	N	36	34	36	35	37	36	36	37	37	37	37	36	36
14 I rely mostly on permanent (specialized) employees	*r*	-.101	**.276***	.164	.113	.129	-.036	.019	**.265***	-.024	-.140	.022	.117	**.275***
	Sig	.251	**.033**	.138	.230	.197	.406	.449	**.037**	.438	.176	.443	.219	**.032**
	N	46	45	46	45	46	46	46	46	46	46	46	46	46
14 The employees of my farm know the practices and procedures to manage kiwifruit vines	*r*	.058	.162	**.261***	.192	.002	**-.291***	**-.263***	-.133	**-.267***	**-.247***	.041	**.253***	.223
	Sig	.345	.134	**.035**	.093	.493	**.019**	**.031**	.176	**.029**	**.042**	.389	**.039**	.060
	N	50	49	49	49	51	51	51	51	51	50	50	49	50
14 we have a good team that jointly resolve operational problems	*r*	.064	.085	**.202**	**.299***	-.008	-.160	-.047	-.095	**-.332****	**-.233**	.062	**.254***	**.210**
	Sig	.329	.279	**.080**	**.018**	.478	.131	.370	.251	**.008**	**.050**	.332	**.038**	**.072**
	N	51	50	50	50	52	51	52	52	52	51	51	50	50
14 I always take decision in consultation with the employees	*r*	.169	**.269***	**.273***	**.314***	-.035	**-.241***	-.088	-.113	**-.242***	**-.302***	-.009	**.245***	**.277***
	Sig	.123	**.034**	**.030**	**.016**	.406	**.050**	.276	.219	**.047**	**.018**	.475	**.047**	**.028**
	N	49	47	48	47	49	48	48	49	49	48	48	48	48
15 How often do you visit the Zespri Canopy website	*r*	.019	.109	.076	-.075	**-.209**	-.037	-.022	**-.239***	-.198	-.071	-.209	-.045	.110
	Sig	.450	.239	.309	.311	**.075**	.401	.441	**.049**	.087	.315	.077	.382	.231
	N	47	45	45	45	49	47	48	49	49	48	48	46	47
17 managing the canopy	*r*	.038	.147	**.341****	.151	-.041	**-.268***	-.074	-.021	.030	.021	-.041	.109	.068
	Sig	.387	.136	**.004**	.129	.377	**.020**	.287	.435	.409	.436	.377	.204	.301
	N	60	58	59	58	61	59	60	61	61	61	61	60	61
17 improve pollination	*r*	.070	.163	**.285***	**.247***	-.092	.080	.103	-.105	-.166	**-.234***	.114	.152	.150
	Sig	.297	.111	**.014**	**.031**	.240	.273	.218	.211	.101	**.035**	.192	.124	.124
	N	60	58	59	58	61	59	60	61	61	61	61	60	61
17 fertilization management	*r*	-.069	.088	**.282***	.168	.080	.119	.184	.045	.182	-.092	.182	**.292***	**.227***
	Sig	.302	.258	**.016**	.105	.272	.184	.081	.367	.082	.242	.082	**.012**	**.041**
	N	59	57	58	57	60	59	59	60	60	60	60	59	60
17 apply bio stimulants	*r*	-.101	.167	**-.261***	**-.226***	-.044	**.226***	-.006	-.113	-.044	**.676****	-.100	-.153	-.143
	Sig	.221	.105	**.023**	**.044**	.366	**.042**	.480	.191	.366	**.000**	.220	.121	.135
	N	60	58	59	58	62	60	61	62	62	62	62	60	61
17 deal with *Psa*	*r*	.179	.044	.090	.143	.115	.191	.138	.060	**.275***	-.072	**.285***	**.278***	**.472****
	Sig	.085	.371	.249	.142	.188	.073	.147	.323	**.016**	.290	**.013**	**.016**	**.000**
	N	60	58	59	58	61	59	60	61	61	61	61	60	61
17 improve your productivity	*r*	.081	.005	.217	.108	-.089	.115	-.059	-.113	.017	-.094	.059	.010	.050
	Sig	.270	.485	.051	.212	.247	.193	.328	.194	.448	.236	.327	.469	.351
	N	59	57	58	57	61	59	60	61	61	61	61	59	60

**. Correlation is significant at the 0.01 level (1-tailed).
*. Correlation is significant at the 0.05 level (1-tailed).